THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

Publishing Office, No. 42 Pine Street.

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XXIV.--No. 2. Whole No. 398. | NEW YORK, MONDAY, JANUARY 17, 1876. | $3 PER ANNUM IN ADVANCE.

A. M. CALLENDER & CO., Proprietors.
G. WARREN DRESSER, Editor,

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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THE SOUTH BOSTON EXPLOSION.

Since our last, the Coroner's jury have completed their investigation in the case of the South Boston Explosion, and the following is the result of their labors, as given by their verdict:—

"That the aforesaid H. N. D. Kemp, Jr., came to his death on the evening of December 22, 1875, at six o'clock and 23 minutes by the explosion of gas, which explosion destroyed the sidewalk on which he was walking, the same being a part of Federal street bridge. The sidewalk was so constructed as to have an open space 200 feet long, 7 feet wide and an average of 2 feet in depth. In this confined space or box the city had caused to be laid a gas pipe the entire length 2 inches in diameter for the purpose of lighting the bridge. The gas from the drip gate or from the defects in the pipe, or both, discharged a sufficient amount of gas in the confined space to render its contents explosive; and the jury are of the opinion that fire was communicated from the lighted street lamp to such explosive mixture through the hollow gas lamp-post near Sumner Crosby & Son's store.

We find that the gas pipes for the purpose of lighting said bridge were laid in a very imperfect and dangerous manner, and that gross carelessness in the care of said pipes was the cause of the explosion.

We also find that the gas pipes at the north end and west side of said bridge are laid in precisely the same manner, and earnestly recommend to the attention of the City Government their immediate removal."—*Boston Globe.*

Much of the testimony given, as is usual in such cases, had very little bearing upon the *cause* of the disaster, being merely statements about the circumstances attending the disaster as they appeared to different persons who happened to be near at the time. From a careful study of all the testimony we gather the following facts:

The bridge at which the accident occurred is one of the draw bridges connecting South Boston with Boston, and is located at the foot of Federal street. It had been remodelled in 1857 under the direction of the City Engineer, the grade being raised by laying new stringers on the old roadway and planking across these. The side walk, however, was so arranged that their was a hollow space under it extending from the draw to the main land. At the time of the repairs of the bridge, the service pipe on the west side of the South Boston end of the bridge, which was put in to supply the public lamps on the bridge, was laid in this hollow space, the lamp-posts extending down into it. The laying of the pipe seems to have been done in a satisfactory manner and was accepted as such by the city. By a contract between the city and the Gas Company, the latter assumed the responsibility for the proper construction, care of and necessary repairs to the service pipe; but a question might be raised as to whether the city in accepting the location of the pipes at the time they were put down had not relieved the company from responsibility in that respect. However that may be, the arrangement seems to have worked well for some time, but then some way or other a leak came. The hollow space was evidently nearly gas-tight. A simple cutting of a good sized hole in each end of the "box," so as to have given a circulation of air through it, would doubtless have prevented any ill results, and would have given timely warning of any leak. But it was not thought of, and when the leak occasioned an explosive mixture was formed, ignited and "went off like a flash of lightning."

How the leak occurred is a somewhat disputed point. Some time after the explosion a drip cock at the end of the pipe near the draw was found open. The man whose duty it was to attend to the drip is a careful, trustworthy man, and testified that he opened this cock on the day of the explosion about 11 A. M., and closed it again as he supposed, but to make sure, went back a second time and examined by making a hole to see if he could smell any leak and could not discover any. Some other witnessess testify that they had noticed an odor of gas there that afternoon. One witness, Mr. Joseph Crosby, Civil Engineer of Boston, gave it as his opinion after careful examination, that the escape of gas was caused by the injury to the pipe resulting from the constant blows the bridge received from shutting the draw; the shock of which was often felt in the building on the land at the end of the bridge.

We give below the testimony of Mr. Edward Jones, the Superintendant, and Mr. F. A Monks, Agent of the South Boston Gas Company, as published in the Boston Globe:

"Edward Jones, superintendent or gas engineer of the South Boston Gas Company, was then examined: Was present at the scene of the explosion about seven o'clock in the evening; had no personal supervision of the laying of the pipes on the bridge; the pipe was laid properly and in a workmanlike manner; but the cavity on the bridge was poor engineering; thought the faulty coupling was a poor piece of work; think it was not proper to lay the pipe in the cavity in view of the knowledge since obtained; the pipe was laid under the supervision of the Superintendent of Lamps; never had any knowledge of the cavity until after the explosion; it would take about five or six hours to fill the cavity with gas from an inch pipe; in my opinion the explosion

was caused by the open valve in the drip gate; the explosive compound would first form near the bridge and flow to the land end of the bridge, and when it would reach that end the remaining space would be filled with pure gas, hence the force of the explosion would be nearest the land end; think the construction of the bridge was very bad, and that if the explosion had not taken place when it did the sidewalk would have fallen, sooner or later, into the channel from its own weight; Mr. Allen directed where the pipes should be laid, and they were laid under his direction and accepted by him when finished..

"Richard J. Monks, Agent and Treasurer of the South Boston Gas Company, testified that he was present on the scene of the explosion at seven o'clock on that evening, and had been there every day since; witness believed that in no human probability could the pipe supplying Crosby's store cause the explosion, as the company have many pipes in the same or a worse condition which do service at the present time, the earth around them keeping the gas from escaping; witness said that if he had been aware of the condition of the supply pipe he would have had it boxed with earth or in some way covered from the atmosphere; there was, in his opinion, a sufficient quantity of gas escaping from the pipe to cause the disaster. An employe of the company, John Nolan, closed, or supposed he did, the valve in the drip gate at 11:30, and returned a second time about 2 o'clock to make sure he had closed it; Nolan was an honest, steady, industrious workman. Witness stated in detail the circumstances of laying the pipe on the bridge after the grade was raised, stating that the South Boston Gas Company laid the pipe on terra firma, from which a branch pipe was laid to the draw; that the city of Boston had full control of the pipe; that they repaired the bridge and made the cavity; if witness were to make arrangements for an explosion he would have fixed a cavity like that under the bridge and left the valve-gate open; witness accounted for the fact of the force of the explosion being greatest near Crosby's store by the fact that the planking was more decayed there than nearer the draw, and the force of the shock would be the greatest in the weakest part, that is, the gas would tend in that direction for an outlet; the company had received no notification at any time of a leak or any trouble with the pipes at the bridge; the drip-gate was not controlled by the South Boston Company, and witness knew of no conditions whereby the company controlled the pipe; pay for the gas burned on the bridge was collected of the city; the pipe was never repaired to witness's knowledge since it was laid eighteen years since; a valve left as the drip-valve was in connection with such a faulty construction of the bridge was a very unsafe arrangement."

Doubtless there will be several suits grow out of this matter, and the testimony given on these trials will be of interest no doubt in fixing not only the cause of the accident, but the responsibility of the condition of the apparatus. In the meantime, if any superintendent or gas engineer has a case where his pipes are run through an enclosed space of this kind, it would be well to overhaul it and have it well ventilated to prevent a recurrence of the same accident.

CARBON IN RETORTS.

For some time there has been a good deal of discussion in the *London Journal of Gas Lighting* upon this subject, in connection with the use of exhausters.

In the edition of December 14th a letter appears from Mr. Joseph Tysoe, of Northampton, giving an explanation of the way in which he thinks the formation takes place. We give a part of it: * * * *

"Perhaps most of your readers know what is meant by the dialysis of gases; but I will explain it for the benefit of those who may not be in that position. By dialysis is meant the property which gases possess of separating themselves from each other when brought into contact with certain porous substances, and in that state they are able to pass through the substance. Gases possess this property in different degrees, and it so happens that hydrogen possesses it in a very marked degree, and will pass through porcelain, or substances of a like nature, with astonishing ease. The small instrument mentioned above will illustrate this. It consists of a sort of cup, made of iron, into the top of which is very accurately fitted, so as to exclude the air, a circular plate of porcelain. From the bottom of the cup a small pipe is carried off, and bent up to about the height of the top of the cup, the vertical portion being of glass. The cup contains a small quantity of mercury, which, of course, rises to the same height in the tube when the pressure inside and outside is the same.

"A small plug is affixed to the side of the cup above the level of the mercury, for the admission and emission of air. Now, if this plug is screwed up tight, so that the air within has no communication with the outer air, and a stream of coal gas or carburetted hydrogen is allowed to impinge upon the porcelain plate, the mercury will be observed to rise immediately in the tube to a considerable height (in the apparatus which I have it rises an inch, which is equal to a pressure in the cup of 13 inches of water). This is owing to the hydrogen of the gas passing through the pores of the plate, which increases the elasticity of the air within the cup; the carbon does not possess the same property, and therefore remains behind.

It is in precisely the same manner that the carbonaceous deposit inside a retort is formed, the clay being of a similar nature to the porcelain. The hydrogen passes through by virtue of the peculiar property it possesses, and the carbon is deposited.

A slight preponderance of the pressure in the retort over that of the atmosphere facilitates the egress of hydrogen. The exhauster removes this preponderance, and the result is a diminuation of the deposit; but it is not so much the removal of the pressere that prevents the deposit as the removal of the gas from the substance which causes the dialysis to occur; and were it possible to fill a retort with gas, and allow it to remain there at the same pressure as the atmosphere, the dialysis would still go on; in fact, it would operate even when opposed by a considerable pressure outside, and were it not for the inevitable cracks in a clay retort, it would be advantageous to work the exhauster at a vacuum.

"In speaking of the pressure in the retorts, I have taken no notice of that due to the dip-pipes."

JOSEPH TYSOE.

Gas-Works, Northampton, Dec. 3, 1875.

This is an interesting point in the discussion of this subject, and we trust that some of our gas engineers will give their views on the subject.

MR. ANDERSON'S METHOD OF PURIFICATION IN ENCLOSED VESSELS.

We reproduced for our readers in our last a cut of a device by Mr. Geo. Anderson, of England, for purification of gas, together with a full description of it from Mr. Anderson's own pen in the *London Journal of Gas Lighting*. There seems to be a good deal of merit in the plan, although it appears as a "suggession," and perhaps some of the details might be improved.

In too many cases in our country we do not get all the benefit we might from the ammonia water. Nature has no waste products in her economy, and the nearer we can approach her in this respect the more profitable and correct will be our course of proceedure. The science of gas making is the last one for a man to settle quietly down in and be satisfied to "do just as we always have." Constant study and application of the principles according to which nature herself works, is essential—pre-eminently so in gas-making—and to constantly advance the science is the duty of all managers, not only from a pecuniary point of view, which we must admit is a very strong point with most companies, but also in view of the obligation every man is under to improve the condition of his fellows.

We will give our readers some further extracts from Mr. Anderson's views in our next.

CORRECTION.—In our remarks in our last number we unintentionally stated the specific gravity of the gas made at Poughkeepsie by the Gwynn Harris' process to be, 740 when we should have said, 640. We trust that this correction will be borne in mind by all who read the article in our last.

On Noxious and Offensive Trades and Manufactures.

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

BY H. LETHEBY, M. B., M. A., ETC.

DISTILLATION OF COAL-TAR.

Another operation which demands care in its management is the distillation of coal tar for the various products derivable from it. There are two kinds of tar from coal, according as the temperature of distillation is high or low, and according to the richness of the coal in hydrocarbon. One is ordinary coal-tar, and the other is the tar from which paraffine oils are obtained. The tar produced from common coals at a high temperature (common coal tar) is always heavier than water (sp. gr., 1·120 to 1·150); it dries freely in the air by oxidation; it contains hydrocarbons with such an excess of carbon that they cannot be burnt in a common lamp; it is almost entirely destroyed by strong oil of vitriol; it contains much sulphur and its percentage composition is about 86 carbon, 7 hydrogen, 6·5 oxygen, and 0·5 sulphur. Whereas the tar produced from cannel coal at a low temperature is lighter than water (sp. gr., about 0·900); it will not oxidate, or dry in the air, it contains hydrocarbons of the paraffine series which are comparatively poor in carbon, and which can be burnt in a lamp; it is not much acted on by oil of vitriol; it contains little or no sulphur; and its percentage composition is about 84 carbon, 12 hydrogen, and 4 oxygen. Both of these tars are the subjects of technical manipulation, and if not properly managed are the the cause of nuisance, as are also the processes used in their primary production. In dealing with ordinary coal-tar, it is proper that it should be stored and carried in air-tight tanks, and left covered with a little water. The delivery of it into tank-barges or tank-trucks, and from them into the tanks of the works, should be by means of pumps and air-tight flexible hose; and the openings of the barges and tanks should be guarded with a box containing hydrated oxide of iron, as in the case of ammoniacal liquor.

The distillation of coal-tar is always conducted in iron stills set over a naked fire—the stills are of varying capacity, from 1200 to 5000 gallons, and the crown of them is always protected with brickwork to keep them hot, so that the later volatile products may not cool and condense and fall back into the still. The time of the distillation of a charge is from twelve to fifteen hours, according to the capacity of the still; and the products are

first condensed in a worm or pipe kept cool in water, from which they are received into a specially contrived box (varying in form and and construction at different places), which permits the several products to flow away by separate pipes (four or five in number, and each provided with a tap) to their several tank-receivers. This box is made air-tight (its cover being guarded by a water valve) and it is provided with an ascending-pipe, which carries the foul gases to proper purifiers before they pass into the furnace-shaft. The gases which are evolved during the process of distillation are, first, sulphuretted hydrogen from the ammoniacal liquor which always accompanies the tar, then gaseous or uncondensable hydrocarbons, and finally the acrid vapors of the superheated pitch with an abundance of sulphuretted hydrogen. These gases and vapors should be made to pass first through a vertical condenser or scrubber charged with a stream of cold water, and then through an oxide of iron purifier with 2 or 3 trays of oxide, and finally to the furnace-shaft. The necessary draft for these operations should be secured by means of a fan, or by the aid of the furnace-shaft. It is proper to mention that, unless there is a draft of very considerable power, the unavoidable leakage from the constantly loosening joints of the pipes will not be prevented. It is right, also, to state that it is dangerous to convey these gases and vapors into a furnace fire, as they are explosive when mixed with air, as they necessarily will be.

The products of the distillation of coal-tar vary in different places. At one time they were but four, namely :—First, ammoniacal liquor and very light naphtha, which come over before the tar in the still begins to boil ; second, a crude naphtha which floats upon water, and is therefore called "light oil" ; third, a creosote oil which sinks in water, and is called "heavy oil" ; and fourth, the residuum, which is a soft pitch. At present, however, in a well-conducted works, the creosote or dead oil is run off in two portions, namely, an early portion, consisting of creosote and heavy naphtha, which is used for burning in furnaces ; and a later portion, which is best suited for the preservation of timber. This is followed by a greenish oil, which is sometimes collected apart and re-distilled with the anthracene oil that runs from crude pressed anthracene ; and then follows a green oil (anthracene oil), which is allowed to flow until it gets very thick from the presence of chyrsen—the residuum in the still being hard pitch. It is in the latter stages of the process, when the high temperature of the still causes the decomposition of the pitch, that sulphuretted hydrogen and acrid vapors are evolved ; and this also is the cause of the nuisance from the hot pitch when it is run off from the stills into open pits. To guard against this, it is proper that the fire should be raked out from under the stills directly the process is over, and the pitch should remain in the stills to cool for ten or twelve hours ; it should then be run into close receivers, or into a properly constructed chamber, and allowed to cool for twenty-four hours before it is discharged into the final receiver. All these should be ventilated so as to convey the vapors through the scrubbers and purifiers before mentioned. An excellent form of receiver for the pitch from the stills is a long air-tight chamber, which will bear internal pressure, and which communicates at the bottom with an outside trough, into which the cool pitch is forced by the weight of the hot pitch at each time of its discharge from a still. The pitch, when cooled to a temperature of about 180° or 190° F., may be freely exposed to the air, and be either run into pits or ladled out into moulds.

It may be interesting to know that the approximative yield of the several products per 1000 gallons of coal tar is as follows :

Crude and light oil, sp. gr. 0·940 to 0·970	from	24 to	40 gals.
Creosote oil.....	" 1·060 " 1·070	" 120 "	180 "
Anthracene oil.....	" 1·080 " 1·095	" 100 "	160 "
Pitch which melts at 176°F.....	.....	.....	3·2 to 3·6 tons.

These products are again submitted to further operations for the purpose of getting benzol, toluol, light burning and solvent naphthas, carbolic and cresylic acids, creosote for fuel and for timber, and anthracene ; but the processes are not generally offensive, and therefore need not engage much of our attention, although a brief outline of them may be useful. The light oil is re-distilled from stills with steam jackets or with closed coils, or by blowing steam into it. That which flows up to a gravity of 0·940 is put aside for benzol and solvent naphtha, and the remainder is used for carbolic acid. The naphtha thus obtained is purified by treating it with strong sulphuric acid, after which it is washed with lime water, and distilled for benzol and solvent naphtha. The heavier naphtha and the first runnings of creosote are washed with a solution of caustic soda for carbolic acid, which is subsequently separated from the alkali by neutralization with acid ; and the green anthracene oil is allowed to stand until quite cold, when the crude anthracene separates from it in granular particles. These are strained off through canvas bags and pressed in hydraulic or screw presses, whereby the crude anthracene of commerce is obtained. The approximative yield of each of these several products is :

From crude naphtha	6 to 10 per cent.	tar acid.	
naphtha and light oil from	20 " 28	"	benzol.
	10 " 15	"	solvent naphtha.
Creosote oil.....	10 " 15	"	carbolic acid, etc.
Anthracene oil.....	10 " 12	"	crude pressed anthracen.

For the purpose of increasing the yield of anthracene with a large admixture of chrysen the distillation of the pitch is sometimes carried on until a spongy coke remains in the still, and under these circumstances the acridity of the evolved vapors is most offensive, and requires the utmost attention to prevent their becoming a nuisance to the neighborhood. The main points, therefore, to be observed in the conduct of works of this description are :

1. The transport and storage of the coal-tar in air-tight tanks or vessels guarded with boxes containing hydrated oxide of iron.

2. The proper construction of the primary receiver of the products of distillation, so that it may freely deliver them by special pipes to their respective receivers, and at the same time convey offensive non-condensable products to the scrubbers and purifiers.

3. The passage of the offensive non-condensable gases and vapors to a scrubber charged with a douche of cold water, then to an oxide of iron purifier, and thence to a tall chimney shaft.

4. The proper cooling of the pitch in air-tight vessels before it is allowed to reach the external atmosphere, and the ventilation of these vessels through the scrubber and purifier before mentioned.

5. The use of a fan or other exhausting power, so as to draw all the noxious gases and vapors from the stills, the pipes, the receiver, and the pitch den into and through the scrubber and purifier before mentioned.

The production of paraffine oil from cannel coal and the distillation of the crude tar, as well as the distillation of petroleum and Rangoon oil, requires like precautions, though not to the same extent, as the products are not nearly so offensive as in the case of coal-tar products.

Dead oil or creosote is largely employed for preserving timber ; but unless there is great carelessness in the management of the operations they are not offensive. The process is conducted in the following manner :

The timber to be creosoted is placed in iron cylinders of great strength and capacity ; and when the end opening is closed and well secured with screws, the interior of the cylinder is exhausted by means of an air pump until there is a vacuum of about 5 inches of mercury. This is maintained for nearly half an hour, during which time the contents of the cylinder are heated by steam pipes. In this manner the air and the moisture of the wood are drawn out of it, when dead oil is allowed to run into the cylinder until it is full. The heat is continued, and pressure is put upon the contents of the cylinder until it reaches to from 100 to 150 lbs. upon the square inch. This is maintained for many hours—the time varying from four to twelve hours, according to the nature of the work ; in many cases the amount of creosote absorbed by the wood ranges from 40 to 50 gallons to the load of 50 cubic feet. The oil is then run out, and when sufficiently drained the timber is ready for delivery. Hardly any precaution is necessary beyond that of preventing the unnecessary escape of creosote oil and vapor.

Before leaving the subject of these hydrocarbons, I may state that the melting of pitch and asphalte for the production of materials suited for the making of asphalte pavements, etc., is in the generality of cases a very offensive operation. All sorts of pitchy matters, as the residuum of paraffine oil (technically called "shellgrease"), Trinidad bitumen, various natural asphalts, and coal-tar pitch are melted in small iron boilers set over naked fires. The boilers are but loosely covered and during the melting and mixing, to produce the material called "bitumen," large volumes of irritating and offensive vapors escape into the air. The bitumen thus produced is, in some cases, again heated with powdered asphalt in specially constructed boilers having a mixer moved by machinery ; and in this case offensive vapors are freely evolved. The charge when thoroughly incorporated and melted is called "mastick," and is drawn off into pails, and cast in moulds for use where the pavement is to be laid. All these operations should be conducted in closed boilers, which should be ventilated by a fan through a scrubber prior to its entrance into the chimney shaft.

The clarification of oil for burning and other purposes is generally effected by means of sulphuric acid, which is well stirred into it. After the black flocculi, formed by the action of sulphuric acid upon impurities, have subsided, the oil is further clarified by means of water and steam, the latter blown into it until it reaches a rather high temperature ; and during this part of the operation the oil is kept in gentle agitation by means of stirrers so as to favor the separation of the oil from water and other impurities. In the case of rape or colza oil, the vapors which are given off are disagreeable and acrid, like mustard, while those of linseed and other oils are also offensive though in a less degree. Cotton oil is refined by by means of a solution of caustic soda, and this also, when subsequently heated by steam, is offensive. The remedy in each case is the carrying on of the operations in closed vessels, ventilated to the furnace fire :

In these operations sulphurous acid and acroleine are evolved, so as to be offensive to the neighborhood, unless they are conveyed from air-tight apparatus into the furnace fire.

Oil boiling for making varnishes, linoleum, leather-cloth, printer's ink, and black japan, is a very disagreeable operation, and requires to be conducted in boilers, from which the fumes pass into the furnace fire to be destroyed.

Fat melting, bone boiling, tripe dressing, and the cooking of sheep's heads, bullock's cheeks, livers, and feet, as well as the boiling of shell fish, lobsters, and crabs, are all offensive operations, and require to be conducted in closed coppers ventilated by special flues, which carry the organic vapors into the fires beneath them.

Third Annual Meeting of the American Gas-Light Association.

HELD AT MASONIC TEMPLE, NEW YORK, OCTOBER 21ST. 1875

[Continued from page 9.]

SECOND DAY'S SESSION.

OCTOBER 21, 1875—10 O'CLOCK A. M.

Mr. Allen—There have been some statements made which I have had no opportunity of answering. I put some questions to a gentleman yesterday who presented himself for inquiry concerning some statements of his. He made the same statements that Mr. Edgerton has made, and I think it is a very easy thing to show that they will not bear investigation; and as some remarks have been made of a personal nature, I would like to say a few words in reply. The Chair has decided that it is not proper to be personal in what we have to say, and I intend to respect that ruling of the Chair. I do not intend to indulge in personalities, but I simply wish an opportunity of replying, for, if I am confident that I am in the right, and the others in the wrong, I do not fear that they will be able to gain any success by such personalities I simply desire, in answer to them, to make a few statements which I am confident are founded on fact, and I think I shall be able to show that they are facts; and that the statements which have been made are *not* facts, and will not bear investigation; and therefore I think I should be perfectly right in objecting to having the other side of the question examined, and their opportunity for reply cut off, by limiting the time so that it will be impossible to answer. By this method, wrong impressions may be entertained, and while the subject is before the Association, I think it should be fully discussed on both sides. The President has stated that criticisms and comments are in order upon any subject that may be started, and I do not think this subject should be dropped until we are all satisfied in regard to it, and have had an opportunity of obtaining all the information we can upon it. Therefore, I simply wish an opportunity of giving such information and facts as I know from actual experience will bear any amount of investigation, and the more they are investigated, the more plainly they will be proved to be true. I do not ask that simply what I state shall be taken for granted, but I ask that when I make a statement of fact those who desire to know the truth will examine for themselves, and if I state what are not facts, then they will be able to determine that; only, I do not like to be cut off from making answer to what I think should be answered. Statements are made here upon one side, and then the time for reply is limited to a few minutes, so that there is no opportunity to show that they are mistaken in the propositions they assert.

The President—The time has passed when you were to close this matter.

Mr. Edgerton—It seems to me that the motion to cut of debate on this question, which it can not be denied is of vast importance, is a retreat on the part of the Association from hearing facts that we have to state upon this subject, and answering those we have stated.

Mr. Neal—I did not make the motion to cut off debate. I supposed that Mr. Edgerton would like to be heard, and then I did not suppose any one else would wish to speak on the subject.

Mr. Littlehales—This is a question that is very much agitated, and I think it should be exhausted thoroughly, as far as possible, Therefore, I think no limit should be put upon the discussion; I think we ought all to get as much information as possible in regard to it. If there is any benefit in oil we want to know it, and if there is not, we want to know that too; so I hope, while we have the subject before us, that it will be ventilated in the most thorough manner.

Mr. Neal—To try the sense of the Association, I move that the discussion of this subject be closed at 11 o'clock. Carried.

The President—I have been requested by the gentlemen who so kindly tendered us the invitation to dinner to say, if you wish to continue your discussion all day long you can do so, and that the dinner can be prepared just as well by 8 o'clock this evening. That will give us from now until night to discuss this matter.

Mr. Price—If this discussion is allowed to go on now, I think we ought to make it as brief as possible. There are a number of us here who must leave tomorrow. I come here at considerable expense and loss of time, and would like to hear all I can before I go away. If we can put off this dining until 8 o'clock I think it would be better.

Mr. Allen—I move, sir, if it is agreeable to the gentlemen who have given us this generous invitation, that it be accepted for 8 o'clock this evening, and that we tender them our thanks. Carried.

Mr. Edgerton—The ground generally taken is, that it is better to manufacture a gas of comparatively low candle power, sixteen candles say, than a high quality gas. I propose to show this impression is a mistaken one. In the cities of Glasgow and Edinburgh, and indeed generally throughout Scotland, 30 to 32 candles is made, with such manifest success, that if I remember rightly, Glasgow has a larger number of consumers, for its population, than any in the world, the laborer even being enabled to burn gas. The gas is sold at a price not greater than sixteen candle gas in London. Again, rich gas is sold in London at a considerably higher price than the ordinary gas, both qualities being manufactured by the same company. Formerly 10 candle gas was made and sold in Liverpool, but by the competition of rich gas, the poor was driven to the wall, and the old company was forced to manufacture rich gas.

The President—You are mistaken. I have been to Liverpool.

Mr. Edgerton—I refer you to Ure's Dictionary of Arts.

The President—That is no authority.

Mr. Edgerton—Then, sir, I refer you to the report of a Parliamentary Committee which investigated price and quality of gas in the United Kingdom. It is there stated that the quality of Liverpool old company gas was ten candles. The result of competition however, forced the poor gas out of existence.

The President—I know all about it.

Mr. Edgerton—That is just what we want to know here. I get my facts from the authorities named. Another fact worth stating is, that the quality of gas is being forced upward, even where there is no competition, in London, though most of the appreciation is due to improved *testing* burners; but the gas is higher in price than formerly, when there was no competition.

Coming home to our own country, we find a vast difference in illuminating power, as furnished by many of the companies, but the result is just such as we might anticipate, those furnishing the rich gas increasing in consumption, the poor gas falling off. In one case within my knowledge, a company manufacturing 24 candle gas has taken away 800 consumers during the year from the poorer gas; in another case 3,500 consumers have shown their preference for high quality gas. Hence, I believe the true solution of the question is, to manufacture a high quality gas, getting pay in proportion, or on an illuminating basis, instead of the cubic foot basis.

In regard to "enriching" coal gas with oil gas, I will simply say that that those whose feelings are eased by calling this new departure "simply an enriching process" to coal gas, can do so. Furnished as "enriched coal gas," the increased quality goes entirely to the benefit of the consumer, and though expense of production is decreased, it is not sufficient to compensate for decreased consumption. I repeat again, this rich gas must be sold on a basis of illuminating power, if you wish to avail yourselves of its great advantages. The facts here given are those of a large practical experience. On the other hand the advocates of coal gas having had no practical experience with oil gas, are in no position to speak with any authority. It is all theory with them. They have not given a single fact, or furnished any data in this discussion. They do not take any position which they are able to sustain by facts or figures. They have not told us what yield can be obtained, even experimentally, nor the quality of the product, nor in fact have they made any public utterance of record, except in one lame case, it was asserted by a gentleman that oil gas *would stratify!* Is he ready now to discuss *stratification?* All the useful information must necessarily come from those who have had practical experience with the manufacture; those who have been working it successfully for years.

Mr. Harbison—I have heard from a stockholder that the Harlem Gas Co. have ceased using the oil gas.

Mr. Edgerton—Yes; and that is probably all you know about it. You do not know the very good reasons they had for ceasing. Some gentlemen who consider themselves well informed on the oil gas question, who have experimented some, dabbled I may say in it, yet fail to come forward and state a single fact publicly. A committee, of exclusively coal-gas men, was appointed to investigate, and have had a year to do it, and yet we have no report from them. We hear of many contradictions in private, but how is it that no one cares to put himself on record publicly as an opponent of the new gas. We do not find their statements in the proceedings of this Association. I think a new committee should be appointed to thoroughly investigate, as suggested by Mr. Neal, chairman of the former committee. It is due to the standing of this Association to get all the information possible on the subject, especially as there are those engaged in the manufacture of oil gas both ready and willing to give it. The data I have given are founded both on experiment and actual practice. I have stated that on a large scale (500,000 cubic feet daily) 1000 cubic feet have been realized out of ten gallons of the cheapest petroleum naphtha or benzine, of 42 candle gas, and that one man can make at the rate of 70,000 cubic feet daily; each bench of six retorts, 120,000 daily. The gas was diluted with about 19 per cent. of air, when it showed 42 candles in the photometer.

The President—Do you mean 19 per cent. of air added to the 1000 cubic feet, or 19 per cent. of the 1000 cubic feet.

Mr, Edgerton—Nineteen per cent. of the 1000 cubic feet.

The President—Then you do not produce 1000 cubic feet, but lack 19 per cent. of it?

Mr. Edgerton—Yes; it was a mixture of gas and air. This yield, so far as the oil gas alone was concerned, was less than 1000 cubic feet for 10 gallons, but the oil gas alone would have been of far greater illuminating power.

Mr. Price—How much will ten gallons of oil give alone?

Mr. Edgerton—A maximum result, on the large scale, of 800 cubic feet of 80 candle gas has been realized.

Mr. Price—How much gas will ten gallons give alone?

Mr. Edgerton—It will give 800 feet of 80 candle, on a large scale, which amounts to 225,000,000 feet a year; that is oil alone.

Mr. Allen—Mr. President: I shall be very brief in what I say. I shall not refer to London nor to Liverpool, nor to any foreign country. I believe that the manufacture of gas in this country has attained a great success, and that we have experienced gas men enough to understand this question, without going abroad. Mr. Patton spoke yesterday of the effect of pure hydrogen. Now that is all out of the question, for nobody pretends to make pure hydrogen. You could not use it; it is not practical at all. We speak simply as a profession, calling hydrogen the product of the decomposition of steam. Everybody understands that water itself is composed of two gases—oxygen and hydrogen. Now, in the decomposition of steam, the oxygen from the steam unites with the

carbon, and the hydrogen is set free, and you have two gases, oxygen and carbonic oxide, containing, I should say, without speaking with exactness, nearly two-thirds hydrogen, and one third carbonic oxide.

Mr. Price—The Association limited the discussion of the subject of oil gas until 11 o'clock. I think Mr. Allen is speaking upon an entirely different question, and is occupying the time which was to be devoted to oil gas.

Mr. Allen—I beg the gentleman's pardon. I am coming right to the point. I was simply premising in answer to the propositions laid down by Mr. Edgerton and by Mr. Patton, and am only going to answer the statements they made, which are not facts.

Now, Mr. Patton laid it down as a proposition that any diluant is a detriment, and that it is resorted to as a "temporary subterfuge only," and my questioning of him was to call out the fact that over 90 per cent. of common coal gas is a non-illuminant, and if that is a "subterfuge only," why then the whole gas manufacture is a "subterfuge only." Now, I say that is not true, that it is not a fact. The basis of coal gas is a non-illuminant.

I agree with Mr. Neal in what he said yesterday, in speaking of the use of oil with coal in the manufacture of gas. If you take any coal that is fit to make gas at all, it will make a gas so near what you want, that you can scarcely get an apparatus which will pay for adding oil to get two or three candles. If you get a gas of very low candle power it is apt to be from poor coal, filled with sulphur, etc.

Now these facts must be true, because when we take gas made by the decomposition of steam, although it has a small illumination—but we call it non-illuminant—and pour in a stream of oil not larger than a small knitting needle, and let it run continuously, it is with difficulty we keep the gas below 17 candles. Sometimes it runs to 18 and then to 16. Consequently, if your gas is 12 or 14 candles, and you undertake to have oil poured in, it would reduce that small stream still lower, to add two or three candles more to it. I don't think it would pay. But when you come to take as your basis of gas a non-illuminant, it takes then from 3 gallons to 3½ and 3¼ to make a 17 and 18 candle gas. And that I state as a fact, and we are ready to show books and figures, and anybody can see if they will take the pains to come. I don't mean to state facts that are not capable of proof.

Now, if people want air, why they are entitled to it. If anybody thinks that air is gas, or ought to be in gas, they are welcome to use that process; we don't like it. Our experience is that every particle of air contained in gas is a deterioration. We don't want any in ours. But it is a free country and everybody that wants to can use such a diluent as they see fit. Our theory is that a rich gas, to be made most profitable and useful must be diluted, and that with a permanent gas, and not anything else. No foreign substance should be admitted into the gas which forms a mere mechanical mixture. We have invited all who desire to see how our process works practically, to come and examine for themselves. I do not state mere theories, but I state matters of fact which I am able to sustain by proof, and which will bear full examination.

We all know what carbon is alone; it has been used for ages. The Esquimaux use it in their wicks. You can't use pure carbon for gas without reducing it to a very small light. Why? Simply because there is in it the heatng element to prevent combustion; and you can't get anything more than a one foot burner with small flame, which will burn in the atmosphere without a large portion of it going off. Every man must know that if you want a little light with a one foot burner, you can have it, but you can't increase that flame without approaching the old-fashioned oil lamps. It will not be a perfect combustion.

Now, in regard to a diluant. At least one question involved in a diluant is, that it shall possess a high heating power, because we all know that light is produced by heat. The greater the heat, the greater the light, and when we use a coal gas of a yellow color we call it rich. If we see cream that is yellow it is called rich. If you see gas of a yellow color, it shows there is too much carbon in it—more carbon than it will burn, because if there is a perfect combustion that flame will be white and not yellow; that every one knows. You have only to see the Drummond or the Calcium light, and you see a white light of great brilliancy, because the heat is increased to its highest power. Now, that is the effect of hydrogen and carbonic oxide united together as a diluant, because it is well known to possess a greater intensity than any other gas. Therefore, it becomes the very illuminant that is necessary for gas.

Then, again, it is well known that it is almost incondensable and will remain longer in the holder, and will travel a greater number of miles without any condensation than any other gas. These are facts that can be established; they are based on scientific principles. Now, if you get a basis for a gas which is incondensable, and which has a high calorific intensity, and substitute that for a non-illuminant, then you get something which has light. Then it becomes a question of how much pure carbon requires to be added, to make 17 or 18 candles. We proved the fact in making over 4,000,000 feet, and we found that it averaged 3 72-100 gallons. Can that illumination be got from any coal at as cheap a rate? I think not. If any one thinks it can they have only to try it. I state it as a fact. We have made the most thorough tests, and I know the statements I make are true. The gas has been tested at 6 deg. below zero, and its condensation at that temperature, was four times less than coal gas at the same temperature. There is no possibility of naphthaline forming in the gas. Naphthaline is formed by a certain condition in gas which never can exist when hydrogen is found in much greater proportion than it exists in coal gas.

I present these as facts, Mr. President, and I do hope that those who are engaged in the manufacture of gas will not take is unkindly. I am interested, it is very true, but I do not state anything that is not true, because I have an interest in it. I trust I have lived long enough to know that nothing is gained by making a statement that is not true, especially when it is open to the investigation of scientific, practical men. I invite every one to look for themselves and see whether or not what I say is true. I only ask that my statements shall not be condemned without examination. Gentlemen should not make up their minds without investigation, and condemn without proof. Why the great and learned Gallileo narrowly escaped death? Because he insisted that the world was round. But it has been proved that it is round, and it will be found that hydrogen and carbonic oxide united together, produce the most permanent gas that can be made, and the cheapest basis for an illuminating gas that can be found; and I believe that adding oil to it gives the cheapest illumination that can be furnished.

Mr. Nettleton read some figures yesterday, and I beg the members of the Association just to look at those given for September. I was there and saw the operation of that company, and they showed me their figures. They charged to the production of September all the help that was necessary to make more than 100,000 feet a day. With the benches they are running they made at the rate of 80,000 feet a day, although it was only charged as 38,000, which would produce 60 or 70 or 80,000; except simply the material 63 72-100 gallons of oil, and a little less than 17 pounds of anthracite coal to the 1000 feet. All the other expenses are charged upon lesser quantities. I think all practical and scientific business men will understand that when you charge as 38,000 feet it bears a much greater proportion to the cost than when you double it. If you have to start a new bench of 39 or 40,000 feet, then you charge for an additional fire but not for additional help. These facts I lay before the Association, and I thank you for the courtesy I have received.

There is one other point I would like to speak of. I have met from coal gas men this objection: They say, "We have seen the gas and know how it is produced, but customers will not take so much of it as they will of coal gas." Of course not. A man does not want as many sperm candles as he does tallow candles. If he has a better quality of gas the less he will want to use of it. The question arises: If a company can make 17 or 18 candle gas so much cheaper than they can 14 or 15 candle gas, and can make a much greater profit on a gas of that kind, ought they to make their customers use a larger amount of gas than comes through their burners, for the sake of having them take more thousands of it?

The President of one company showed me his figures (you will excuse me from mentioning what company it was) for eight months of last year when they were running our process; this year they are not. He was going to lay them before his Board, and had prepared them for that purpose. Those figures showed that they had paid $37,000 more for their material this year than they paid last year. Their consumers taking more gas this year than last; made up $30,000 of that, and the company was $7000 out of pocket. Taking this statement shown me by the President of a company who had prepared it to lay before his directors, the question arises—Ought there to be such a tax levied upon consumers where it is not one cent of benefit to the company? To make them pay $30,000 in these times, especially when the company is not making a cent of money out of it, but on the contrary, losing $7,000, is a pretty heavy tax; and he stated that if he gave a close statement, it would be still greater, for he charged the coal and labor this year at the same rate he did last year, while it was cheaper. I give this as a statement of a President of a company; whether you believe it or not, it is a fact.

Mr. Neal—What was the name of that company?

Mr. Allen—I have asked to be excused from stating. There are some of us who might guess who it was. Although I did not ask whether I might make the statement public, I desire to be courteous toward the gentleman who gave me the figures.

Mr. Neal—Was it the Citizens Gas-Light Company of Brooklyn?

Mr. Allen—I have no right to prevent the gentleman from guessing.

A member—Guess work is always best when you happen to hit.

Mr. Allen—I cannot help it if the gentleman hits it the first time.

Mr. Neal—Have you seen the reports of that company for the last 12 months?

Mr. Allen—I am speaking of a statement he showed me about a month ago, and that is within twelve months. Whether it is true or not it is not for me to say. That President don't require me to stand up here and vindicate his integrity and character. I say he showed me a statement he was going to lay before his Board. I trust the courtesy of this Association will give to the president of every gas company the proper standing to which he is entitled. I did not make the statement for him, and therefore I am not called upon to vouch for it. I simply say that if any president of a gas company here showed me figures, I would certainly assume that they were correct until the contrary was proven.

Mr. Olney—Are you aware whether the president of that company made the statement that you have just mentioned to his board of directors, as covering the last 12 months?

Mr. Allen—I have stated that these figures were shown me about a month ago.

Mr. Olney—I am speaking about 12 months. Did they cover the operations and results of the last 12 months? Did the statement of the operations of that company, which we have seen published, correspond with the statement you speak of?

Mr. Allen—According to my reading, it did not. If that president found he was in error, and modified his statements, I am not responsible for it. I am speaking of the figures he gave me about a month ago.

Mr. Harbison—We have heard this morning two different methods of making gas pretty thoroughly

blown up—favorably, of course. Now I would like to ask the gentleman why it is that a large gas works in Connecticut, in which his patent project for making gas was formerly used, have given it up?

Mr. Allen—I can answer that question very well. I am glad that the gentleman asked it.

Every gentleman here knows that it takes a great while to bring any great improvement to perfection. Millions of people did not believe that it would succeed. At that time we had nothing but common retorts, and we found, after the most thorough investigation, that steam could not be perfectly decomposed in iron apparatus. All those failures were made with iron retorts. We could not decompose steam perfectly in these retorts, and so the profits were destroyed. We found an improvement in the use of clay retorts, but we had no retort manufactory. I sent to Belgium and got a retort, because it was said that they made them better over there; but they did not prove to be much better than ours. We made gas for the company to which the gentleman refers for five months, and after we left they carried it on for five months longer.

A member—I don't wish to interrupt the gentleman; but the time is up.

The President—I will give him two minutes longer, as some little time was lost before he began.

Mr. Allen—I was through.

The President—You can have another minute.

Mr. Allen—I was going on to state that when they had completed their arrangements, the superintendent ordered a large number of retorts; afterwards he thought he would have them a little better, and he ordered them an inch larger. I saw a great many of them when they came, and they had to be made an inch smaller, and he would not use them. Orders were given that if they would be ready by such a time he would take them, but he could not get them. The old benches were taken out, and so they were obliged to fire up the new benches. That was the reason why our method was discontinued the superintendent told me the last time I saw him, but he had not altered his opinion of the value of our process. The President of that company was old Judge Boardman, and if any member of this Association thinks he is a more careful man than Judge Boardman was, then he has a very good opinion of himself.

Mr. Harbison—I would like to ask the gentleman a question.

The President—You will have to ask the consent of the Association. I am ordered to close this discussion at 11 o'clock, and the time is up.

Mr. Edgerton—I move that Mr. Harbison be allowed to place himself on record on this petroleum question. I move that the discussion be continued for 10 minutes to give him an opportunity to do so. Carried.

Mr. Harbison—I am not an expert in petroleum. I have not "dabbled" in it as some gentlemen have done. I only rise to ask a question. I have been told by a stockholder in a company on this Island that within a week the gas works at Harlem, which have been using petroleum for some time, have given it up.

Mr. Patton—Mr. Edgerton stated that the commercial value of gas shall be its illuminating power. He further stated today that he diluted his gas with air. Everybody of course knows how much air destroys this commercial value. I had occasion within a week or two to make some tests with different gases, or to be present when they were made. One gas contained about 10 per cent. of hydrocarbon, and the gas was mixed with 8 or 10 per cent. of air. The illuminating power of the gas was about 20 candles—between 19 or 20. Another gas was tested containing from 5 to 6 per cent. of illuminating hydro-carbon. This gas was not mixed with air, but it contained about 40 per cent. less of this commercial value; and this hydrocarbon contained an illuminating power of 20 candles. For instance, if a company has poor gas and wants to increase its illuminating power, they use cannel or some other enricher. If Mr. Edgerton destroys this illuminating power by mixing air with his gas, he consequently destroys the value. I think there is something wrong about it which he ought to explain. We all know that air mixed with gas not only reduces the illuminating power, but it also takes off the heat, and causes it not to burn properly. It creates a loss of combustion. The further consequence of mixing air with gas increases the weight of the gas. An increase of weight without illuminating power requires more pressure, and more pressure requires larger mains, and these are items of expense. For myself, I am not in favor of having heavier gas without having a greater illuminating power. I wish Mr. Edgerton would explain what he thinks about that? If, in the first place, the true standard of its commercial value ought to be its illuminating power, and if, in the second place, he deteriorates this illuminating power, there are two propositions directly in conflict with each other, as it seems to me.

Mr. Edgerton—You have stated the case correctly so far as regards the effect which the introduction of a certain element will have upon the illuminating power of gas, but you do not comprehend the point I make. What I mean is that, instead of reducing the illuminating power of the gas, you should sell it at the illuminating power. We don't want to dilute it with air at all. If diluted, it should be diluted with coal gas, but we don't want to bring it down to the standard of coal gas.

Mr. Littlehales—It is a very good theoretical idea, but I do not think it is practical. I believe it would be impossible to carry it out.

Mr. Edgerton—It is carried out in practice in 26 places in the United States.

Mr. Allen—I ask the indulgence of the Association to answer the question put by Mr. Harbison as to why the use of petroleum had been discontinued at the Harlem works. We had not for some time arrived at a successful result in the use of retorts. Afterwards we found a new retort which we believed would answer the purpose.

Mr. Olney—Were these retorts used?

Mr. Allen—No, sir; they did'nt pay for them. The parties with whom we contracted were over ridden by the President and Board of Directors. The engineer has left because he was ordered by the president to let down those benches. He resisted it to the utmost; and they have now got a new superintendent and engineer. The last time I saw that engineer, he told me he would not go back on any thing he had done, or on any opinion he had expressed. Now then I ask the Association to look a little deeper than the mere fact that they let those benches down.

The President—The time is up, sir.

Mr. Allen—I am up, sir.

A member—You are down, now!

The President—Mr. Peebles, of Scotland, is here, and on behalf of the Association, I would request, if it is agreeable to him, that he will tell us something about the manufacture of gas in his country.

Mr. Peebles—In the discussion of this paper I was carried back to a paper written by Dr. Stephenson MacAdam, of Edinburgh, in connection with the manufacture of gas from oil.

I know I shall be asked several questions about this discussion when I return to Scotland, by persons who are interested in the subject, and there are one or two points I should like to be informed upon in regard to the practical manufacture of the gas on an ordinarily large scale. The first is whether the gentleman who wrote the paper used a vertical or horizontal retort. 2d. The method of introducing the oil—whether the retort was full of incandescent coke, or whether he merely dropped the oil in the retort. 3d. The specific gravity of the oil he used, and then, above all, the stability of the gas. We have heard in Scotland that the gas is of 70 candle power. I should like very much to see it, but the question above all others is as to its stability—whether it will stand very long without condensation.

Dr. MacAdam made a very interesting series of experiments; and if you refer to the London *Journal of Gas-Lighting* of a year or two ago, you will see a very exhaustive report of his experience. There was one thing, however, that stopped his progress in its manufacture, and that was the utter want of stability of the gas, otherwise it would have been very successful. That is one thing in particular in regard to this gas that I should like to be informed upon, so that I may be able to answer questions which will be asked me when I get home.

As to the decomposition of steam in the manufacture of gas, Mr. Spice, is going very thoroughly nto that question at present. He made a speech upon this subject at the last meeting of gas engineers at Leeds, and he is very successful in the employment of this process. He attributes the success he is meeting with now to vertical retorts—blowing steam down through a vertical pipe, instead of sending it in horizontal retorts. He attributes all the success he has met with to that little change, and he is very hopeful of making a thoroughly practical success of the manufacture of this gas.

I do not know that I shall be able to give this Association much information in regard to the manufacture of gas in Scotland. Not being a practical gas maker myself, I am not personally concerned in these matters; but being very much interested in the subject, I am always on the *qui vive* to see what is going on, and as far as possible keep up with the progress that is being made.

There are one or two things receiving a great deal of attention just now at home—one is "mechanica stoking."

That is being, in several instances, very successfully followed. One of these machines is in operation near Glasgow, and some of the London companies are now adopting them. I should like very much to see this machine put in operation in your great country where labor is so expensive, and where I think it could be used under much more favorable circumstances. In respect to relieving the pressure from the hydraulic main; of all the apparatus which have come into notice, that of Mr. Hawkins will probably take precedence of all others. I can scarcely describe it without a diagram. It is very simple, and it is automatic. There are no levers, chains, bolts, or anything of that kind about it. In the hydraulic main, in the interior of the pipe, there is a cup, while on the outside of the pipe there is a little iron water level. The gas blows the water that is contained in this cup out when the retort lid is being put on, and when it is taken off the water finds its way over into this cup and reseals the pipe.

There is another thing which I think is worthy of your attention. A Mr. ————, one of our northern stars, had he lived, would have made a great success of experiments in the remarkable property of paraffine oils for taking away completely the illuminating power of coal gas. I made some apparatus for him, and was very much interested in his experiments. Unfortunately, before he had time to prove them, he died, but his brother-in-law, one of our most clever chemist, took the matter up and brought it before our Association. Of course, that property had long been known, but Mr. ———— was the first to bring it into prominence by his experiments.

I am very sorry that I am obliged to touch upon patents, but I should like to mention a patent process of a Mr. ————, by which, instead of taking the gas immediately from the hydraulic main to the condenser, he throws the gas into a large chamber, and instead of cooling he heats the gas, so that, as it comes from the hydraulic main, it is a series of globules, and these globules each contain a particle or a quantity of gas. Mr. ————'s theory in regard to this matter is very beautiful also in regard to the property of paraffine oils abstracting the illuminating power of coal gas. This invention will make a very great change in the quality as well as the quantity of the gas. From these series of experiments of Mr. ————, there is no doubt but that the gas suffers a great deterioration.

I beg to thank you gentlemen for the courtesy you have shown me. (Applause.)

A member—What do they pay for coal in the city of Edinburgh; and what is the selling price of gas?

Mr. Peebles—I am sorry that I cannot give you the

price of coal. The price of gas at present is 5 shillings and 2 pence per 1,000 feet, and the illuminating power of the gas I could not state exactly. There are two companies in Edinburgh, the ———— Gas Company, and the Edinburgh and ———— Gas Company. They give 28 candle gas. Dr. ———— read a paper before the society in Glasgow, stating that the two companies had agreed to give the same quality of gas; but Mr. ————, engineer of the gas company, contradicted that statement, and said that they would give 30 candle gas. I burn the gas of the ———— gas company, and they give 28 candles. I think that is the average illuminating power of the gas in Scotland.

A member—Do they make it entirely from cannel?

Mr. Peebles—Yes, they make it entirely from cannel. I do not think bituminous coal is used at all, we have such a supply of cannel. There is an impression abroad that if you go above 30 candles it is very difficult to burn, and goes off in smoke.

Mr. Patton—Do I understand Mr. Peebles to say that he would like to have his questions answered?

Mr. Peebles—Yes, sir; I would like to have them answered either in public or in private. The first question was whether your retorts were vertical or horizontal?

Mr. Patton—They were horizontal.

Mr. Peebles—My next question was, what was the specific gravity of the oil used?

Mr. Patton—I have used the various grades of petroleum and its residuum, ranging in gravity from 65 to 73 degrees.

Mr. Peebles—What was the stability of the gas?

Mr. Patton—I have kept it in small holders for several months at a time, extending over a portion of the winter and a portion of the summer?

Mr. Peebles—Of 70 candle power?

Mr. Patton—Yes, sir. The works I have built have holders containing some four or six thousand feet connected with holders of a larger size.

A member—How many cubic feet?

Mr. Patton—About 8,000 feet. The Philadelphia and Reading Railroad Company use it pressed in cylinders. They take a number of cylinders, I think they have some sixty or more, and pump the gas into them at a pressure of 300 pounds to the inch, and there it remains until wanted for use in the passenger cars. Then it is run into small cylinders under the cars and there it remains, say about a week; that is, one cylinder carries about a week's supply.

A member—I would like to know if, in the experience of the railroad he names, there is any condensation in these cylinders under the cars at the last end of the charge.

Mr. Patton—I believe not, sir. They previously had used coal gas, and found considerable trouble from condensation in the cylinders. They did not use naphtha gas at first. In using coal gas they pumped it directly into the cylinder. Now they pump it into this battery of cylinders, and the condensation that takes place in these first cylinders is thrown off, so that it leaves very little if any.

A member—All the condensation takes place in the first operation?

Mr. Patton—Yes, sir; I would say that there is a condensation that reduces the gas below 70 candle power, when a pressure of 260 pounds is applied.

Mr. Harbison—What condensation did you find in the gas that you spoke of having kept over so long?

Mr. Patton—I did'nt find any material loss in the gas. I did not subject it to a very close test. It was a very small holder, and the gas remained over from about March until along in the summer. I have also, for several months at a time, kept it compressed in a cylinder.

The President—Gentlemen: if you do not wish to continue this discussion, Mr. Littlehales, of Canada, will read a paper on "Wooden Pipes for Gas Mains."

Mr. Littlehales then read the following paper:

Wooden Pipes for Gas Mains.

By T. Littlehales of Hamilton, Ontario.

In compliance with a request to prepare a paper, for the consideration of the Association at the present meeting, and being desirous of contributing as far as I can to the fund of information which is elicited at these meetings, I would like to call the attention of the Association to the question of wooden pipes for gas mains, as I know there are a number of our members who feel an interest in this question.

I am fully aware that in discussing this question I shall be occupying the debatable ground, and shall very probably bring my cast iron friends down upon me in full force, bnt if they can show that I am wrong either in premises or in conclusions, both the Association and myself will have been benefitted by this discussion of the subject.

There are quite a number of gas companies on this continent which have laid a greater or lesser number of wooden pipes for gas mains, but I have never been able to obtain any reliable data respecting the results obtained by their use. In many cases they are so placed in connection with the cast iron mains, that it would be next thing to an impossibility to obtain anything like an approximate statement of what they are doing, and any data that could be obtained respecting them would be mere guess work.

When this subject was first brought under my own consideration, a number of objections at once suggested themselves to my mind against the use of wooden pipes for gas mains, but further examination of the subject showed that some objections were more fancied than real, while others could be easily overcome, and that in some respects at least, wooden pipes had the advantage over cast iron ones.

The principal objections which most readily suggest themselves to the use of wooden pipes for gas mains are:

1st. The liability te leakage from the nature of the material itself.

2nd. The difficulty in making the joints tight, and

3rd. Their liability to decay.

As regards the first objection, there is no doubt but that the porous nature of the wood would allow a considerable quantity of gas to pass through it, unless some means were taken to stop the pores of the wood. If, for instance, the pipes were made out of dry wood and laid without a coating of any kind, they would in all probability be useless for gas mains, but the usual method of making and treating wood pipes is to take the green logs, bore them, and dip them in hot pitch or tar, make the tenons and sockets and cover them with paint, put hoop iron rings on the socket ends to keep the pipes from splitting when they are driven together, and get them laid in the ground as soon as possible after they are made. The idea is that the sap and moisture being retained in the pores of the wood, that and the pitchy covering prevents any escape of gas. But although the pipes of which I have had a most favorable experience, were made and treated in the manner just described, I do not think it is the best system for making them, for several reasons.

1st. That when the pipes are made in this way, it is absolutely necessary that they be laid soon after they are made (which is not always convenient or practicable), or else they are liable to crack and become useless.

2nd. The wood being already full of moisture, the pitch or tar cannot penetrate into it, and so the preservative properties of the tar are lost, and also that the coating is liable to chipp off and leave the wood bare on the outside, and

3rd That the use of pitch or tar is objectionable as a coating for the inside, because the gas softens it and fetches it off. And it seems to me that there would be a danger if the frost should get at the pipes, of the moisture being converted into ice and tearing the fibre of the wood, but the latter objection may perhaps be more a theoretical than an actual objection.

But notwithstanding, and in spite of these objections (which can easily be overcome), wood pipes of 10 inch diameter and smaller sizes can be made to be perfectly satisfactory in every respect; and in places where the extremes of temperature between summer and winter are as great as they are in some parts of the United States and Canada, wooden pipes have most unquestionably the advantage over iron ones, in as much as wood being a non-conducting material, there is no expansion or contraction as with iron mains, neither would there be anything like the same amount of condensation.

As regards the second objection, viz., the difficulty in making the joints tight, I may say that if the pipes are carefully made, there is not the slightest difficulty in making the joints perfectly sound and tight, by smearing the tenons and insides of the sockets with a thick red lead paint before they are driven together. Some parties recommend the use of hot pitch for making the joints with, but the use of such material for this purpose should be carefully avoided, because the gas will soften it, and the joints will in time become leaky.

The service pipes are connected in different ways, some simply have a short piece of taper pipe and drive it into the wooden main and connect the service pipe to it; but there are two objections to this method, viz., a danger of splitting the wood pipe in driving the taper pipe in, and that in case of any settlement of the ground and main, there would be a great liability of the taper pipe to draw out of the main. The plan I adopt is to put an iron clamp round the wooden pipe, and screw the service pipe into and through this clamp into the wooden pipe; this makes a secure and sound connection of the service to the main.

In reference to the third objection, viz., The liability of wooden pipes to decay, it is a question which can only be settled by time, as far as their use for gas mains is concerned, although there can be no doubt but that wood will remain sound for a great number of years under certain conditions, the principal of which is that it is protected from the atmospheric changes, which we all know will readily dostroy either wood or iron, if they are not protected in some way or other. But I believe that they will remain sound and tight for a great many years; in the generality of cases until the mains become too small and have to be replaced by larger ones; and that in certain kinds of earth they would last fully as long or longer than iron ones. We all know how rapidly cast iron pipes are destroyed in certain kinds of soil; and for a swampy locality I would most unquestionably give the preference to wooden pipes over cast iron ones. And any gas company that may be able to obtain wooden pipes advantageonsly, and is disposed to try them, need not be deterred from doing so by any fear as to the results, if the work is well and carefully done.

In November, 1873, the company with which I am connected required to extend their mains to supply a new section of their district, and as the locality and situation was such as to present an excellent opportunity for testing the merits of wooden pipes, the directors authorized the laying of one and a half miles of four inch wooden pipe as an experiment. They were made in the manner before described, and were laid by the company's men under my own direction. The joints were made with very thick red lead paint, and the greatest possible care was taken to ensure sound work. They were laid in sections of twenty or thirty at a time, and then tested by letting the gas into them, and carefully examining and applying a light to every joint and to every inch of the main.

When the work was completed, we commenced to use the main, and it was allowed to remain for about eighteen months, by which time any settlement of the ground and pipes and consequent leakage, ought to have shown itself. A 100 light meter was then tested and fixed at the inlet to the wooden main, through which the whole of the gas passed, and at the end of one week the whole of the meters on that section were examined and the full quantity which had passed through the large meter was indicated on the consumers meters, without one single foot of loss. At the end of two weeks more another examination was made, and the result was precisely the same, not a single foot of loss. At the end of another fortnight a third examination was made, when there was a loss

of 150 feet, equal to 7.14 cubic feet per mile of pipe every 24 hours, or 3.29 per cent. on the gas delivered into the main.

Three subsequent tests were made, but inasmuch as during the same period several alterations had been made in the service pipes, by which a considerable quantity of gas had been wasted, and a leak having been discovered at the outlet coupling of the large meter, there was of course a very considerable increase in the quantity of gas lost, but *including* these losses of gas, the results for the whole period of testing, amounting to eighty-nine days, showed a loss of only 24.2 cubic feet per mile of main every 24 hours, or equal to 8.3 per cent. on the gas delivered into the main; and considering the loss from the leakages above mentioned are included, I think the record is a pretty good one, especially when it is borne in mind that the consumption on that section was very small indeed—only nine consumers on the whole length, and a total average consumption per day for the eighty-nine days of about 400 feet only, or about 46 cubic feet per day for each consumer.

It may be asked why there should have been absolutely no loss shown on the two first tests, and a loss on the subsequent ones, but I think that can be satisfactorily accounted for in this way: The first two tests were made during very hot weather, and the gas was being measured by the consumers' meters at a considerably higher temperature than it was at the large meter, and so although there appeared to be no loss, yet if the gas had been measured at the same temperature in both places, there would have been some loss on the first tests, because it would be almost impossible to pass gas through that length of pipes of any material that they could be made of, and not lose some gas if it was measured at the same temperature at the ends. And the fact that the leakage or rather the unaccounted for gas increased as the weather became colder, is strong evidence that the reason before given was mainly the cause of the difference. But although the quantity of gas lost was considerable, when calculated on the per centage of gas delivered into the main, yet when calculated on the mileage of pipe it was exceedingly small; in fact, if the whole of our mains in the city of Hamilton were doing as well as this section of wooden main, even calculated on the most unfavorable test of the whole series, our leakage account would only amount to 2.28 per cent. on the gas sent out from the works; and if we compare it with the results of the whole 89 days tests, and all our mains were doing the same as this section of wooden main, our leakage account would only amount to 1.02 per cent. on the gas sent out, which is a far different result from anything I have ever known in reference to cast iron mains.

There is one matter which I would like to refer to here, although it is not strictly connected with the subject of this paper—it is concerning the method of calculating the leakage of a gas company; the general way of doing this is by the per centage on the gas sent out from the works, which is a most misleading and unsatisfactory system, and utterly unreliable for the purpose of comparing the results of different gas companies, as will at once be seen on examination. Take, for instance, a gas company whose annual make is 50,000,000 cubic feet, and whose leakage account is equal to 10 per cent. or 5,000,000 cubic feet, and that company doubles its consumption without increasing or adding to their mains, it is evident that while the actual amount of gas lost would not be diminished the per centage of leakage would be reduced to 5 per cent. Or take another instance—two companies whose consumption is equal, but whose mileage of mains is very disproportionate, it is evident that although the mains may be equally well laid, and the whole of the work equally well done in each case, yet the *per centage* of leakage would be very much larger in the one case than the other, although the *actual* loss per mile of main may be exactly the same in each case; and therefore for the purpose of comparison of the results of different gas companies, the per centage method is a misleading one, and the more reliable way is to calculate the loss per mile of pipe.

Returning to the question of wooden pipes: At the time we laid the wooden pipes, the price of iron was very high, and it was costing us for four-inch iron pipes laid in the ground complete, including everything, $1·80 per yard, and the wooden pipes cost, including everything, $1.40 per yard, say 23% cheaper than the iron ones. The makers of wooden pipes are well known, and any one can very easily ascertain the comparative cost of wooden and iron pipes. The question of cost will doubtless in most cases be the great consideration in reference to the adoption of wooden pipes; and although I do not wish to be understood to be an advocate for the general adoption of wooden pipes in preference to iron ones, yet I must say that in certain localities I would prefer wooden to iron pipes at almost any price.

In conclusion, I may say that I am prepared, and shall be pleased to demonstrate the facts I have stated, to any one who is sufficiently interested in the question to visit Hamilton, and make a personal examination of the matter. My object is to place before this Association the results of a fair and practical test of the merits of wooden pipes for gas mains, and I trust that it may serve to bring out in discussion additional facts and information on this subject.

Mr. Neal—I would like to ask Mr. Littlehales if he stated that he intended to have it understood that the percentage should be calculated upon the length of the mains. Supposing the mains of one company are 2 feet in diameter and those of another are 18 inches, and the mileage of both is the same. Do you mean that you would calculate the leakage according to the superficial surface?

Mr. Littlehales—Of course it will have to be compared in that way. But take two companies whose mileage is greatly disproportioned. The mileage of one may be nearly double that of the other. One may say that their leakage is 15 per cent., and the other that their leakage is 7 per cent., and the latter may be the worst result, because it is a percentage on the larger quantity.

Mr. Neal—A twenty inch main exposes more surface than a two inch main. Supposing 20 miles of 20 inch main and 20 miles of two inch main—would the leakage be the same?

Mr. Littlehales—I think the lesser friction on the larger main would counterbalance the difference, because, as you increase the size of the main you decrease the friction. We know that the friction on larger pipes is much less, in proportion, than on the smaller ones.

Mr. Neal—I take it for granted that in a city the mains are larger than in the country. I think the proper way is to reduce the mains to a given size, and then everybody in making their calculations would have a common basis to go upon.

Mr. Littlehales—Of course that is a more satisfactory method; but the per centage system is not a satisfactory one.

A member—I would like to know if there is always an increase in the leakage in iron mains with lead joints. I will state that, in my case, there is a constant increase going on and has been for a good many years, until about three years ago, when the lightning struck a church whose service pipe led into the main, and I suppose it followed the service pipe into the main for about 700 feet each way. The gas instantly began a great leakage. It took place in the afternoon, and we did not discover it until the next morning, but being very dark at the time it was noticed that the gauge went down. We did not think anything about the lightning. We supposed that the gas was being lighted as it was so dark when the storm came up, but the next morning we discovered that the lightning had reached the pipe and that the loss came from that. We then went to work to find the place. We made holes in the ground, put a bar down and applied a match (we almost always find a leak in this way) and we finally went over the whole of our mains and I suppose we then found all the leaks, at any rate we reduced the leakage very much; but I would like to know whether there is a constant increase in leakage in iron pipes with lead joints.

Mr. Harbison—I would like to ask when this occurred?

A member—It was about three years ago. We went to work and kept at it until we went over the whole of our mains, and now I believe the whole of our pipes are about tight, at any rate we don't know of any leak. I suppose, however, that the increase will go on, and that eventually we shall have more leaks.

Mr. Harbison—Was the lead in the joints melted by the lightning?

A member—No, sir; we found that for about 700 feet in each direction from where the lightning had entered the main, all of the joints were leaking a little, and we also found that all of the joints had loosened a little, so that we could run a thin knife between them.

A member—What percentage of reduction was made after stopping the leaks you refer to?

A member—In the first place the works were built about three years ago. They were quite tight after stopping two leaks, and the loss was so little that we got paid for about as much gas as the meter registered. But afterwards we found that the meter was not filled in right, and so there was a little loss, but not perhaps over 5,000 feet a month, but it kept on increasing until it got up to 20,000 feet a month, and then when this lightening went into the pipe, it ran right up, probably at the rate of nearly 100,000 feet a month. Now, I don't think our loss is more than 10,000 feet a month, for some four or five miles of mains.

A member—How much consumption have you?

A member—About 4,000,000 a year; at present it is a little over 20,000 feet a day.

A member—I think when the leakage commences it will continue and increase. In the works that I have charge in putting down the pipes they were put very shallow in the ground—but a few feet below the surface—and I invariably found that in the spring of the year, when the frost went out of the ground, the lerkage increased. It went on from one year to another, until at last we lost about twenty-five per cent. of what we made. I then started to do something. I got a number of steel bars and went over every foot of pipe. I succeeded in reducing the leakage from 25 per cent. to 10 per cent. We had then somewhere in the neighborhood of 30 miles of pipe, and in tightening up these joints that were leaking I examined them carefully, and in the winter I observed a little ring of light around the joint no larger than a hair, showing that, when the pipe was contracted by the cold, the joints separated a little; and, in the summer time, the pipe went back but the lead would not go back.

By going over them and tigbtening them up, I stopped the leakage, but I think the great fault was that the pipes were not put down deep enough. I think they should be put down deep enough so that there will be something like a medium temperature; then they will not be affected by heat or cold, and when you do that the joints will remain secure. I think that is the best way to stop the leakage—at least I have found it so.

Mr. Price—One of the most important points in the construction of works for the distribution of gas has just been hit in my judgment—the proper laying of pipes, and the proper making of joints.

The question has been asked whether, in the use of iron pipes and lead joints, the leakage will go on increasing constantly. There are so many different considerations connected with this matter, that it is almost impossible to answer such a question satisfactorily.

I will state our experience. Some eight years ago, when I took charge, we had a large leakage. Part of the joints had been made with lead and part with cement. We instituted a very thorough system of searching for leaks, by keeping a gang of men constantly employed perambulating the streets, punching down with bars, applying a match, applying their noses, and using every possible means to discover the

leaks. We found a great many and corrected them. We found, in taking up old pipe and substituting larger pipe, that the work had been very badly done. It had been entrusted to irresponsible persons. In many instances the joints were simply sieves through which the gas had been escaping for some time. Then we adopted a different system. In the first place, we lay the pipe from four to five feet deep, below the frost and below the possibility of there being much contraction or much expansion. I hold that to be a fundamental point—to lay the pipe deep—and the question of how deep it should be laid depends upon the locality. In Minneapolis where the frost goes down from five to ten feet, I should be pretty sure to go below frost. I can see no other way to get along with the difficulty.

In the next place, we are careful to use the best spun-yarn. We don't buy an inferior quality, but we get the best. We don't buy any old leads. We buy nice pig lead—soft, nice pig lead. We then have a most thorough examination of the pipe. It is tested with the air pump and mercury in order to see if there are any leaks. If any leaks are discovered they are corrected before the pipe is put down. By these means we have reduced our leakage 50 per cent. per annum. I believe if every company would have their pipe thoroughly tested under heavy pressure, and then lay it deep enough, and have the joints well and carefully made, it would, to a very great extent, solve this troublesome problem.

A member—I have no doubt but that this is the true idea. I found that some pipes which had been put but a little way in the ground all had little leaks in them. They had been there about twenty years, and we had found no leak before. This has led me to think that the true way was to make rigid joints, and have them recorded so that you could know where to find them if you should want to get at them.

A member—What do you call a rigid joint?

Answer—One made of iron so that it will not move.

Mr. Price—I omitted one little point. It is important that there should be a superstructure—something laid in stone, for instance, to support the pipe. It is of the utmost importance that the pipe shall be so laid that it will not settle at some points more than at others, and thus disturb the joint. We take a great deal of pains to lay our pipe in such a way that it will not subsequently settle enough to disturb the joints. I will say one or two words in regard to wooden pipes. A small gas works some thirty miles from us laid wooden pipes, but they have proved a failure there. I am told that they are crushing in and rotting, and they are taking up a large number of them.

Mr. Floyd—I feel some confidence in speaking upon the subject of iron. A great many gentlemen know that there has been a great contest in regard to iron and clay. I do not make iron pipe now, but I am sorry to differ with my friend Littlehales, from Ontario. The experience with wooden pipes which we have had here in the Middle States, has generally been disastrous. The only place where they have been used to any great extent was at College Point. They laid four or five miles of them there. At the time their works were very small, and they wanted to extend them, They were paying a very nice dividend, and they thought that by extending their works they could pay more. The question arose as to what kind of pipe they should lay. Finally, they decided on wooden pipes, and they put down four or five miles of them. The consequence was that they used up all the capital of the company and stopped paying dividends. They lost by leakage more gas than they got paid for. It was impossible for them to keep a supply for their customers with all the retorts they were working. Whether it was in the manufacture of the pipe, or the laying of the pipe, I do not know; but the facts are as I have stated them.

The President—I should be glad to hear from Mr. Littlehales as to how these pipes were prepared.

Mr. Littlehales—They were simply green logs—pine logs. They were bored out and dipped into a kind of pitchy composition. I suppose it was a sort of thick tar. It was heated, and after the logs were dipped into it, it formed a sort of pitchy covering. I don't think the pitchy covering is suitable for the inside, because the gas will soften it. I state that in my paper. So far as the question of durability is concerned, I could not answer that having had no opportunity to test it in my own experience. I was very much pleased with the remarks of Mr. Price; but, so far as soundness is concerned, I think they will compare favorably with any other pipe laid for the same length of time, provided they are properly prepared at the ontset. I should like to hear from Mr. Floyd, on this point, in regard to the pipes that were taken up at College Point.

Mr. Floyd—They were down, I think, about two years and a-half. I think it was about that long from the time they extended their works until the pipes were taken up. I have very good reason to remember in regard to the matter, as I was a little interested in the company at the time. They were in a flourishing condition, and it became necessary, like it is in all growing cities, to extend their works, and they concluded to try these wooden pipes. Now, I don't pretend to say what was the cause of their failure, but I know that in two years and a half from the time they were laid, these wooden pipes leaked so badly that it was almost impossible for the company, using all the retorts they had in the retort house, to keep their customers supplied with gas. They had sufficient retorts, had the pipes been tight, to have supplied three times the amount they did; but it was impossible to keep up the supply on account of the leakage. There were between three and four miles of the pipes.

Mr. Price—I wish to make a suggestion to Mr. Littlehales in regard to the method of preparing his pipe, and what, I am afraid, he may anticipate. In our town we have had a large amount of Nicholson pavement laid down. The custom was, after the pine blocks were prepared, to dip them in boiling tar—baptize them by immersion in the boiling tar—not keeping them long enough to saturate them through, but simply covering the outside with hot tar. The blocks were then set up in the ordinary way. In a very short time all those blocks began to dry rot and crush in and the result was a lamentable failure; and the reasoning upon the subject (and I havn't heard it disputed) was that this failure was caused by the fact that the sap in the timber was kept in by this process of covering the wood with tar, and that it could not escape, and, consequently, that it had within itself the elements of dissolution. I am afraid that may prove to be the case with this wooden pipe that Mr. Littlehales has laid down. If they took green logs, bored them, and covered them with pitch, they may find one of these days that their logs are dry-rotting.

Mr. Harbison—Alluding to the durability of wood—within the past 10 days I have had occasion to test the matter. We had to put a new service pipe in a street where this Nicholson pavement was laid. The wood was green white pine, the blocks were sawed at a mill near by our works, and we furnished the tar. The party who put the pavement down boiled the tar in the middle of the street, and dipped the blocks in it, or immersed them, as Mr. Price has expressed it. I thought they would be a failure at the time, and so expressed myself. In taking them up, however, I found that they were perfectly sound to the centre, much to my surprise and disappointment, and the only way I could account for it was that we make a very superior quality of tar. (Laughter.)

Mr. Littlehales—Most of the Assoctation remember that in my paper, I said I did not think it was the best way of making them to dip them in boiling pitch. I think the suggestion of Mr. Price a very sound one, and that is the only danger I have anticipated from using our pipes. I simply thought the paper I read would bring out more information on the subject, because our company would like to have extended the wooden pipes, if they had reason to believe they would be permanent. So far as the durability is concerned, I believe it would be greatly increased by saturating them with creosote. If the creosote were forced into the wood by pressure, as railway sleepers are impregnated in the old country, that is, they are put into a cylinder and the creosote is forced into the wood at a pressure of from 150 to 200 pounds to the square inch, I think the result would insure permanency. By this method the wood is filled with this material. On the Great Western Railway I have seen these sleepers taken up, after having been exposed for 10 or 12 years to all kinds of weather, and they were just as sound as they were the day they were laid, through the preservative agency of the creosote. I think the same process would apply to wooden pipes. I think that in certain localities wood has an advantage over iron, being free from contraction or expansion. Especially do I think this is the case in swampy localities, where the ground is constantly wet. In such localities it is almost impossible to keep the joints of iron pipes tight. We had some pipe laid in swampy ground, and the drips required to be pumped out every few weeks. I am very anxious to get all the information I can on the subject, and should like to hear from any of the members what their experience has been.

A member—Do you prefer wooden pipes to cast iron pipes, at the same price per foot?

Mr. Littlehales—Not as a general thing; but in swampy localities I think thay have an advantage over iron. As to their durability, as I said before, if they were impregnated with creosote. I think it would be greatly increased.

A member—Do you think that iron is better than wood?

Mr. Littlehales—Under certain conditions.

Mr. Floyd—Mr. Littlehales theroy in regard to the expansion and contraction of iron is correct. He is not only right in theory but in practice. I believe I know as much about the expansion and contraction of iron as any man of my size in the country. (Laughtor.)

The President—How much do you weigh?

Mr. Floyd—I decline to answer that question. (Laughter.) In any locality where the sun is likely to shine during the whole day for the twenty-four hours. (Laughter.) I don't mean that of course. That's a little longer time than the sun generally shines, even in the most favored locality. A man who lives in a cold country, the frost goes very deep, and he is right in saying that where the sun shines upon the ground and keeps it from freezing, the iron would not contract as it would when laid in localities where the sun did not shine upon the ground for a sufficient length of time to have any effect. If the sun shines upon a certain part of the ground and keeps it from freezing, and on either side of this place the ground is frozen, there the iron will contract, but where the sun strikes the ground the iron will expand.

Mr. Olney—I will give you some facts from my own experience. Last winter I was in the island of Porto Rico, and while there I examined the works and the pipe. The pipe they used was 8-inch pipe of Russ joints, and extended from the works to what was called the ————. There were about 12 miles of pipe. A portion of it was French pipe, made out of zinc and covered with yarn and then pitched, and a portion of it was encased in wood. It had been laid for something like nineteen years, the iron pipe and the zinc pipe together. One part of the city became entirely destitute of light while the other was supplied. By direction of the Governor General a gang of men was sent out to inspect the condition of the pipes. The wood which encased the pipe was what they call beach cedar, that is, red cedar. The pipe was inside of that and was made of zinc. The wood, in every case where they opened it, was found to be entirely gone; it was laid about two feet deep. It was found that the pipe, where it was covered with the coating I have spoken of, was a mere shell; by pressing it with the thumb it would all crumble. In the iron pipe there was not a single leak discovered in the whole distance that it was laid.

A member—What was the condition of the Russ joints?

Mr. Olney—First class. There were one or two lengths of the pipe that had not been kept out of the water. There was a stream of water in the city, and it had completely undermined one or two lengths. There was some planks laid on top, but the pipe had been entirely washed out. I merely mention these facts because I understand that this French pipe is coming into the market. It has been in use it Matanzas and one or two other places, St. Johns for one, I believe, and it has proved to be an utter failure, while the iron pipe that I have spoken of in Porto Rico when it was taken up, was as good as it was 24 years before.

Mr. Neal—I believe that we have discussed this subject sufficiently. I don't wish to seem to try to rush things, but Mr. Turner of Charleston has a cube or brick of spent lime that he would like to have us look at, and he is ready to answer any questions that may be asked him.

[To be continued.]

THE AMERICAN GASLIGHT JOURNAL AND CHEMICAL REPERTORY
Publishing Office, No. 42 Pine Street.

A. M. CALLENDER & CO.,
PROPRIETORS.

Editor—G. WARREN DRESSER.

PUBLISHED ON THE 2ND AND 16TH OF EACH MONTH
At No. 42 Pine Street, New York.

This is a recognized official organ of—
LIGHT, HEAT, MINING INTERESTS, STEAM, WATER-SUPPLY, PATENTED INVENTIONS, VENTILATION, SANITARY IMPOVEMENT, AND GENERAL CHEMICAL SCIENCE.

TERMS

SUBSCRIPTION—Three Dollars per annum, in advance.

AGENTS

NEW YORK—AMERICAN NEWS COMPANY, 119 and 121 Nassau St
BOSTON—S. M. PETTENGILL & Co., 6 State Street.
PHILADELPHIA—COX, WETHERILL & Co., Ledger Buildings, Phila.
Germany—B. WESTERMANN & Co., of New York.

MONDAY, JANUARY 17, 1876.

Correspondence

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Mr Patton Replies to Mr. Allen.

TREVERTON, PA., December, 1875.

Mr. Editor: Understanding that the "Correspondence" department of your paper is, like the rest of the paper, intended for the general interest and information of your subscribers, in which personalities have no part, except as they may elicit facts of general interest, I have no desire to push Mr. Allen any further into his especial stronghold of personal vituperation. But if we may judge by the amount of "cry" they have produced, my statement and letter have struck pretty deep.

I accept Mr. Allen's grammatical correction, and am glad that he was so hard pressed for a weak point to strike at, as to choose one entirely outside of the question. I accept this correction the more cheerfully, when I remember the hilarity with which the Association so frequently greeted Mr. Allen's *frequent* oratory.

I can also thank Mr. Allen for quoting several of the salient points of my letter, and so helping me to impress them upon the minds of the gas-producing fraternity. "That gas which will not give any light is not worth any money for illuminating purposes," is the statement that I have made, and which Mr. Allen views as an "intolerable absurdity." Query? Does any person not interested in "water-gas" patents" so view it?

The praise that the Vassar Professor gives so freely would scarcely have come to hand, but for the small quantity of oil gas that he received, and which would have served him far longer unmixed than "watered." Let us hope that he will continue to praise it, and not follow in the footsteps of those who have praised and deserted before him.

As for Mr. Allen's intimations of false pretences or "disguise" on my part, I can assure him that he is welcome to any benefit he can obtain by such charges. The members of the Gas-Light Association who were present at the meeting when my statements were first read, know that I presented them simply as a contribution to the general fund of information—the gathering of which is the prime object of the Association—and as such, the obtrusion of my special interest in the matter would have been utterly out of place. And I think too, that men who are unprejudiced and honest will acknowledge—even if Mr. Allen does not—that the statements were frank and truthful, concealing nothing, exaggerating nothing, something to be relied upon where they were statements relating to accomplished facts, and worthy of careful consideration where they mere statements of opinion.

If Mr. Allen really possesses a valuable patent for gas apparatus, why does he not use it in some of the many towns not yet supplied with gas, where a really cheap and good light is much needed? I find more than enough such towns to keep me fully employed in a legitimate and honorable mode of introducing and rendering available both to myself and to the public, a really valuable improvement. With its value thus proved, its introduction and use in established gas works becomes easy. Above all things I despise patents whose suppositious value is in their ability to plunder established industry.

Mr. Allen refers to a solitary instance where his patent is in use, viz., an opposition company at Pough keepsie. I am able to refer to ten gas-light companies, beside individuals and other corporatians, for whom I have built works, ; and no works that I have built have ever abandoned the "pure oil gas."

When Mr. Allen can say as much for his process, his statements will have a weight that they do not now carry. Until then I would warn all established gas companies not to "water" their gas, unless they want to see trouble. Yours respectfully,

J. DESHA PATTON.

Mr. Somerville on Street Loss.

GAS OFFICE, KNOXVILLE, TENN.,
January 6, 1876.

Mr. Editor: As there has been no more information furnished us through the columns of the Journal, regarding the extraordinary sale of 10,400 cubic feet of gas per ton of coal carbonized, we will conclude that there must have been some mistake in the figures; indeed, when we add 10 per cent. for leakage to the above amount. it shows an unprecedented make from the average American coals giving the average candle power.

And now I should like to say a few words about the statement or data of the companies whose unaccounted for gas amounts only to 5 per cent. No doubt many gas engineers have been a little troubled since these figures have appeared in the Journal, why they can't reduce their unaccounted-for gas to 5 per cent. I think I can show them that they need not be troubled, that the thing is impossible. and that those companies claiming a loss of only 5 per cent. have also made a mistake in their figures.

We will take a gas works where the annual make is, say 80,000,000 cubic feet. The gas, when it issues from the purifiers, is more or less saturated with moisture, as the pumping of the dips at the tank will testify. This volume of moisture is measured with the gas by the station meter before it enters the holder. One cubic foot of water will produce 2000 cubic feet of vapor, and it has been demonstrated by actual experiment, by a meter placed on the outlet pipe of the holder, that the loss of gas alone is between 4 and 5 per cent.

The gas now leaves the holder and enters the cold pipes of the streets; and the fact that drips are placed at the lowest point on the line of mains, to receive the liquids which condenses from the gas, and that these drips have to be periodically pumped, is sufficient evidence that the gas continues to contract in volume, before it reaches the consumers' meters; this decrease in volume has been estimated by high authorities at 3 per cent.; here we have 8 per cent. of unaccounted-for gas, which has not *leaked*. And now as to leakage, I care nothing how tight one may make a joint, or how solid and firm the iron of the main pipes may be, gas will escape from them. We are all familiar with the fact that air gets into the pipes of our houses; if not, try the experiment—shut off the gas at the burners, then shut it off at the meter, let the pipes remain all day in that manner, then however tight and perfect the fittings may be, you will find when you try to light the gas at night, it will be several seconds before the gas will burn, owing to the air in the pipes. Now, the supposition is, that if air gets into the pipes gas will get out. If this is the case with wrought iron interior fittings, what shall we say to the miles of much more porous cast iron mains, with thousands of joints all liable to leak, which leakage can only be detected when it has arrived at the surface of the ground. A low estimate of the loss by leakage proper would be 4 per cent. This will make the total unaccounted-for gas amount to 12 per cent. In some cities with a works of the capacity stated, the per centage of loss will be much higher, but in no case will it be lower. Yours respectfully,

JAMES SOMERVILLE, Sup't.

Gas-Light Intelligence.

United States.

Price of gas in Wilmington, Del., has been reduced from $2.70 to $2.50 per 1000 feet.

PRICE OF GAS IN BROOKLYN.—The gas companies of Brooklyn agreed last week to reduce the price of gas to consumers from $3 fo $2.75 per 1000 feet.

PHILADELPHIA GAS WORKS.—This company sent out about 9,000,000 cubic feet of gas last Christmas. They have discontinued the use of the "Spencer process."

ELECTION OF DIRECTORS OF THE MANHATTAN GAS COMPANY.—The annual election of Directors of the Manhattan Gas Co., on the 10th inst., resulted in the following choice: Moses Taylor, John J. Cisco, Samuel Sloan, John R. Ludlow, Percy R. Pyne, Wilson G, Hunt, Mason Young, James H. Young, and Chas. Roome.—*N. Y. Evening Post.*

DECREASE IN CITY GAS BILLS IX BROOKLYN.—The city gas companies have offered to light the streets and public buildings at the cost of $2.25 per 1000 feet. For years they have been charging $2.50. The Commissioners of City Works recommended to-day the acceptance of the new bids.—*N. Y. Even'g Post.*

PRICE OF GAS IN NEWPORT, R. I.—Previous to last summer the price was $4, with 12½ per cent. off if paid within ten days. It was then reduced to $3.50. with 30 cents per 1000 off for prompt payment. And now a still further reduction is to be made, so that the price will be $3 per 1000 nett. The discount given for prompt pay, saves the trouble and expense of a collector.

ACCIDENT AT UTICA GAS WORKS.—We understand that owing to some stoppage in the pipe leading from the cupola to the washer, there was a blow out at Utica about ten days ago. By starting up the coal benches they were enabled to supply their consumers after a short time, until necessary repairs could be made, which we understand have been effected, and the process started again.

A DISPUTED GAS BILL.—There is considerable excitement among the taxpayers of Edgewater, Staten Island, in regard to the action of the Board of Supervisors in allowing the Citizen Gas Co. $9,000 on an old contract made five years ago for lighting the street lamps, after the Court of Appeals had decided against the company. The original bill was about $6,000, and the new Board of Supervisors passed it with interest added, making the amount $9,000. It is understood that the County Treasurer will not furnish the money on the vouchers issued by the Board. —*N. Y. Herald.*

GAS EXPLOSION.—An explosion of gas occurred at

Hall's rubber store, corner of Franklin and Federal streets, about half-past two o'clock on the afternoon of December 31st. Fortunately the accident was not of a very serious character; the cause thereof being apparent, unlike the late disastrous Federal street explosion, there is no mystery to breed apprehension. New gas pipes have recently been put in the building, and for the purpose of making some connections with pipes already in use the gas had been turned off. The work was supposed to be complete and the gas was turned on again at one o'clock in the afternnoon. In about an hour the strong odor of gas through the building indicated that there was a leak.

The windows of the upper room were raised, but the state of the atmosphere did not greatly improve and a gas-fitter was called in. He soon traced the leak to a closet in the basement where a gas pipe lay behind a water box. Applying a match to the pipe behind the box to locate the leak definitely the gas ignited, causing an explosion which threw the gas-fitter to a distance of ten or twelve feet and completely riddled the closet walls. A damage of $200, or thereabouts, was done to the building, and the unfortunate gas-fitter was quite seriously burnt about the face, and considerably bruised. The explosion would have been more serious had it not been for the previous raising of windows.—*Boston Journal. Jan. 1st.*

Chemical and Scientific Repertory.

Tar water may be employed for dyeing silk or wool ashen gray. The stuff is first mordanted with weak perchloride of iron, by soaking in the solution some hours. It is then drained and passed through the bath of tar water. The oxyphenate of iron, which is thus precipitated on the fabric, gives a very solid color.

It is reported that Mahmoud Pacha, a member of the Council of State, obtained authorization some time ago to conduct mineral explorations in the districts of Lom and Belgradjik, district of the Danube. The engineers employed by his Highness have returned to Constantinople, bringing with them specimens of iron ores and of bitumen, and are said, besides, to have discovered coal of first-rate quality.

Magnets or armatures for electro-motors may be softened as follows: Heat the iron to an even dull red heat all over; and if the surface of the iron has not been faced off in a machine, lightly file it to remove the scale, and then immerse it in common soft soap, allowing it to remain therein until it is quite cold. Then reheat the magnet to an even red heat whose redness is barely perceptible, and bury it in pulverized lime, wherein it must also remain until quite cold, when the metal will be found as soft as it is possible to make it, and the blade of an ordinary penknife will cut it. At the second heating the iron will emit a light blue flame, showing the effect of the immersion in the soft soap. The conductability of the magnet may be, by this process, very much increased.

Washing Smoke.—An apparatus for washing smoke, and so depriving it of its character as a nuisance, is in operation at a factory at Menlimontant, Paris. A fine shower of water, traveling in the direction of the smoke, and at five times its velocity, is projected into the chimney, where it mixes with the smoke, taking up the soluble gases and precipitating the impurities carried up with the smoke by the draught. The foul water is dischargod into a cistern, where it is collected and a fine black paint is got from it.

The Water Supply of Virginia City, Nevada.

The success of the Virginia and Gold Hill Water Company in laying another wrought iron main over the Washoe Mountains calls for special notice. It i now about two years since the company first projected and first put into active use their first great effort in putting down a wrought iron riveted (12-inch diameter) main across the Washoe Mountains and valleys intervening. The total length of the inverted syphon is about seven miles. The inlet is elevated above the outlet 460 feet, supplying about 2,000,000 of gallons per day. The leading of such a stream across a deep valley is declared to have no parallel in the history of hydraulic engineering. The pressure on the pipe is enormous—estimated at not less than a column of water 1530 feet in height. Great as was this first triumph, we have to-day to record an achievment far in advance of it. Although directed by the most eminent engineering skill, and manufactured by the most able riveted pipe-makers on the continent, regardless of cost, it was found that the enormous pressure, which no human foresight could anticipate, produced such a strain upon the rivets and lead joints as to require daily expenditures of money and time to repair the breakages constantly occurring. Thirty-five tons of lead were used to make the joints at the beginning, and a constant further expenditure of lead followed to make the joints good. The success of the effort and the increasing demand on the company's supply led to the result which to-day we chronicle.

Having overcome the natural obstacles of mountain hights and valley depths, the engineer of this company (Mr. J. B. Overton) determined to struggle with the mechanical difficulties already referred to. Knowing that lap-welded seamless pipe was made up to six and eight inches, with screw couplings, for many purposes—such as steam, gas and water—it occurred to him that if seamless lap-welded pipe could be made large enough and strong enough, and with suitable screw couplings, the trouble of leaking lead joints would be removed, and being perfectly smooth on the inside, would give the water easier and ampler flow. Relying on his practical judgment, the company sent him with carte blanche directions to scour the eastern mills and find, if possible, the desired commodity. After a thorough investigation he found that the National Tube Works, of Boston, Mass., were the manufacturers of the size and quality of pipe he required, and were rigging up to make still larger for hydraulic purposes. He also found their patent sleeve coupling to be just the thing he required. After consulting with their engineers, and receiving suggestions from the experiences they had already gained, and stating fully his requirements. he contracted with the company to supply the pipe under guarantee to do all that he required. It was to be ten inch diameter lap-welded seamless pipe, 16 feet lengths, screw joints, with patent sleeve couplings, capable of sustaining 800 pounds pressure to the square inch, with bends for curves, etc. As these were supplied, our indefatigable fellow townsman began his work with the eyes of every member of his craft upon him. As the work neared completion the curiosity and anxiety increased only to be surpassed by the astonishment and wonder which followed his triumph. The water was at length turned on and ran from end to end at once without interruption and in three days the whole seven miles was perfect. Instead of using 35 tons of lead, as in the first, 120 pounds only were used, and this for safety bands at the bends on a few of the highest points the pipe crossed. There was a larger flow of water from this ten inch seamless lap-welded pipe than had flowed from the twelve inch riveted pipe over the same ground, fed from the same source, with the same pressure and alike in every other circumstance. We congratulate not only ourselves and the Water Company and their enterprising superintendent, but also the National Tube Works, of Boston, Mass., who have greatly aided a new departure in dydraulics and added to their fame as the makers of the finest and largest diameter hydraulic pipe (for they now make it 15 inch) that the Old World or the New has ever seen, and demonstrates the wisdom of the managers af the California Mechanics Fair in giving to the Notional Tube Works Company a special medal for the exhibit made there of this seamless lap, welded pipe.—*From Iron Age, Dec. 30th*, 1875.

Distribution of Temperature on the Earth.

The distribution of temperatures upon the globe is a subject of profound popular and scientific interest. More than any other, it affects the distribution of living forms, not only in zones of climate, but in geological time. The contour of the earth's surface, and the relations of land and water upon it, may produce important local changes, or establish local faunas an floras, but these are scarcely more than modification of grander and more general results. Arctic plant may, indeed, flourish under the equator, but only on mountains where an arctic climate prevails. Heat determines the limits equally of the vine, the palm of the tropics, the cereals of the temperate zone, and the food of the reindeer. Whether or not tree-ferns grow in Pennsylvania, and forests of pine in the Arctic Circle, depends on climate. Nor is this a phenomena of the present age only. Geology proves from its records that, while a torrid zone may have existed since climates began, yet polar and temperate regions have witnessed changes both of climate and of life in wonderful succession, and in periods of immense duration.

The causes which have contributed to these results have been sought and studied by some of the most eminent scientists of our time. Humboldt, Sir John Herschel, Sir William Thomson, Lieut. Maury, Sir Charles Lyell, and more recently Dr. Carpenter and others, have investigated the subject in many of its aspects, and their conclusions are before the world; but no one, we believe, has presented it from so many points of view, or attacked its complex problems with greater vigor than Mr. James Croll, whose volume is now before us. His conclusion is, that not only great secular changes ot climate, but the distribution of temperatures upon the earth's surface at the present time, are due to causes which alter the volume, intensity, and direction, of the trade-winds and other prevailing winds of the globe. For the question at issue is not the amount of heat received upon the earth's surface, but the means by which it is distributed.—*Popular Science Monthly.*

The Education of the Mechanical Engineer.

The following are the closing remarks of Prof. R. H. Thurston's address recently delivered to his graduating class at the Stevens Institute:

"President Porter, of Yale College, gives you terse and sound advice in regard to your conduct and bearing as men. "Young men," said he to his pupils, "you are the architects of your own fortunes. Rely upon your own strength of body and soul. Take for your star, self-reliance. Inscribe on your banner 'Luck is a fool; pluck is a hero.' Don't take too much advice; keep at your helm, and steer your own ship, and remember that the great art of commanding is to take a fair share of the work. Think well of yourself. Strike out. Assume your own position. Put potatoes in a cart over a rough road, and the small ones go to the bottom. Rise above the envious and the jealous. Fire above the mark you intend to hit. Energy, invincible determination, with a right motive, are the levers that move the world. Don't drink; don't chew; don't smoke; don't swear; don't deceive; don't read novels; don't marry until you can support a wife. Be in earnest; be self-reliant; be generous; be civil. Read the papers. Advertise your business. Make money, and do good with it. Love your God and your fellow men; love truth and virtue; love your country and obey its laws."

Baked Air.—When the air is baked through a hot furnace and heated to a high degree, and then passed into a room, such air should be called baked air, and it is about as bad a form of lung food as can be taken. Nothing but headache, faintiness, drowsiness, and dullness can come from its use.—*Herald of Health.*

American Patents.

Patents issued for week ending Dec. 14, 1875.

	Class.	Number
Device for Impregnating Timber with Antiseptic Fluids—J. Huntington, Cleveland, O.; filed Dec. 6 and 7, 1875	85	{171,135 {171,136
Condenser—J. B. Root, N. Y.; filed May 18, 1875	148	171,175
Filter for Liquids Holding Solid Impurities—E. S. Hutchinson, Baltimore, Md.; filed Nov. 12, 1874.	155	170,952
Gas Lighting by Electricity—Hinds & Smith, New York; filed June 2, 1875	64	171,131
Gas Furnace—A. Parks, England; filed Nov. 4, 1875	99	171,162
Gas Holder—L. Markes, San Francisco, Cal.; filed Oct. 9, 1875	64	171,028
Manufacture of Gas—Jos. P. Gill, Newark, N. J.; filed November 29, 1875	66	171,117
Hydrant Valve—H. James, Hudson, N. Y.; filed Aug. 28, 1875	167	171,138
Street Connection for Hydrants—Folliard & Travis, Flatbush, N. Y.; filed Nov. 18, 1875	167	171,116

Patents issued for week ending Dec. 21, 1875.

Anti-Incrustation Compound—L. N. Lye; filed Nov. 19, 1875	148	171,297
Hydrocarbon Burner and Gas Generator—A. J. Griffin, Lowell, Mass; filed Nov. 9, 1875	90	171,278
Coke Ovens—E. S. Gobiet, Austria; filed Nov. 27, 1875	61	171,371
Condenser for Illuminating Gas—G. W. Edge, Jersey City, N. J.; filed Oct. 4, 1875	66	171,363
Gas Meter—J. Morgan, New Orleans La.: filed Nov. 29, 1875	64	171,407
Gas Regulator—G. McMillan, La Crosse, Wis.; filed Oct. 28, 1875.	64	171,236
Treating Natural Gas—McElroy & Young, Pittsburgh, Pa.; filed Nov. 23, 1875	66	171,400
Hydrant—M. Allen, Natick, Mass.: filed Nov. 5, 1875	167	171,206
Hydrants from Freezing—B. Kent, Binghampton, N. Y.; filed Nov. 1, 1875	167	171.228
Hydraulic Cushion Valve—C. E. Emory, Brooklyn, N. Y.; filed Sept. 9, 1875	152	171,218
Centrifugal Water Wheel—O. J. Backus, Newark, N. J.; filed August 20, 1875	168	171,256

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

24 Pine Street, New York City.

January 17, 1876.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	Par.	Bid.	Asked.
Harlem	$1,850,000	50	135	138
Manhattan	4,000,000	50	307½	310
Metropolitan	2,500,000	100	159	160
" Scrip		...	103	105
Mutual	5,000,000	100	109	110
New York	4,000,000	100	149	150
Westchester	466,000	50	100	105
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	238	240
Citizens	1,200,000	20	122	125
" Scrip		...	101	...
Peoples	1,000,000	10	88	99
" Bonds		...	96	98
" Scrip		...	95	98
Metropolitan	1,000,000	100	95	97
Nassau	1,000,000	25	122	125
Williamsburgh	1,000,000	50	147	150
" Scrip		...	100	102
Out of Town Gas Companies.				
Buffalo Mutual, N. Y	750,000	100	50	50
Baltimore, Md	2,000,000	100	190	...
Brockport, N. Y	25,000	...	...	85
Citizens, Newark	500,000	...	75	...
Derby of Conn	160,000	100	...	80
East Boston, Mass.		25	112	115
Hannibal, Mo	100,000	100	58	60
Hartford, Conn	700,000	25	41	43
Hempstead, L	40,000	100	...	100
Jersey City	386,000	...	160	...
Jamaica, L. I	25,000	100	...	100
Jacksonville, Ill	120,000	50	80	90
Lewistown, Maine	400,000	100	...	75
Lima, Ohio	60,000	100	10	...
Laclede, Mo			...	123
Peoples, Jersey City		...	130	140
Peoples of Albany	1,000,000	100	31	40
Peoples of Baltimore		25	108	...
Rochester, N. Y		100	50	...
Richmond Co., S. I.	300,000	...	100	105
Fort Wayne, Ind		100	...	105
Woonsocket, R. I.	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
Jacksonville, Ills		82		

Gas stocks sold at auction were—

86 shares of New York, @ 152½ @ 152¼; 66 shares Metropolitan, @ 159; 180 shares Citizens, of Brooklyn, @ 139; 40 shares Manhattan, @ 307½. At private sale—80 shares Jacksonville, Ills, @ 82; 100 shares Peoples, of Albany, @ 31.

A. VAN TUYL, AGENT,

143 Duane Street, N. Y.,

CONTRACTOR AND DEALER IN

Cast Iron Pipe for Gas, Water, Etc.

WITH THE

"ROBBINS PATENT JOINT."

Laying Pipe UNDER WATER a Specialty.

The Robbins Patent Joint is the best and cheapest known method for connecting Gas and Water Mains, and is believed to be the only absolutely gas-tight joint made. Deflections of the Pipe, caused by the settling of the earth in the trenches, do not impair nor cause his joint to leak.

For further information and references address

398-3m A. VAN TUYL, Agt., 143 Duane St., N. Y.

TO GAS COMPANIES, AND CITY GOVERNMENTS.

DYOTT'S PATENT

CHAMPION STREET LAMP

Doubles the Light with the same quantity of Gas used in other Lanterns. *All others* waste half their light, illuminating the sky, or if the top is of metal, absorb it.

Single Top Glass Lamps both Globular and Square become heated if a good light is put in them, and rain, hail or snow falling upon the heated glass breaks it. When one glass is broken the wind will either blow the flame against the others and break them, or destroy the entire Lamp. *Nine-tenths of the breakage and cost of repairs of other* street lamps is owing to that cause.

Dyott's "Champion" is the only double top—the only Lamp that has the Opaline White Dome, which is a *never changing reflector;* it doubles the power of, and throws the light to a greater distance. It is also a perfect *protector*, shielding the heated top or the lamp from all inclemency of the weather. The white dome is kept cool by the passage of air between it and the transparent globe below. Rain, hail or snow will never break either the globe or dome. The globe rests upon rubber cushions, and is supported laterally by elastic springs, so that contraction or expansion of the globe, or jarring of the post will not break it. They can be cleaned in one-fourth the time required to clean other lanterns. The metallic portions are of iron, copper and brass, and are the most durable, economical, efficient and cheapest lamps in existence. For public buildings, and wherever an ornamental and powerful light is required, they are made in clusters of 2, 3, 4, 6, 7 and 10 lamps, which have no equal in this or any other country for *beauty, durability, efficiency* and economy, either in cost, use or ornamentation. Designs furnished when requested for specific purposes. Gas companies, or those who have the lighting of Cities in charge, are solicited to communicate with us in reference to the agency for its introduction.

The Franklin Institute has awarded our Champion Lamp the highest premium: (they give a silver medal) and its Committee on Science and the Arts has recommended it as the best lamp in use. It has also invariably taken the highest premium at every Exhibition at which it has been presented, and elicits the strongest commendations wherever it is used. We have several new and handsome patterns of Posts for Corporations, Parks, public and private use, also for clusters of lamps, that are not excelled in beauty or price at which they are furnished.

374-6meot DYOTT MANUFACTURING CO., 114 South 2nd Street, Phil'a, Pa.

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☞ In looking for advertisements, see figures 1 to 12, within brackets, at head of advertisement pages.

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American Meter Co.—West 22nd st., N. Y., Arch and 22d st., Phil., 548 Washington st., Boston 11
Cast Iron Gas and Water Pipe—S. Decatur Smith, York and Moyer streets, Phila., Pa 8
Cast Iron Gas and Water Pipes—R. D. Wood & Co., Philadelphia Pa 10
Cast Iron Gas and Water Pipe—Jno. McNeal & Sons, Burlington, N. J 8
Franklin Foundry and Pipe Works—Jas. Marshall & Co., 23 Nineteenth street, Pittsburgh, Pa 2
Gas Valves (Chapman) 75 and 77 Kilby st., Boston, Mass 3
Gas-Burners—C. Gefrorer, 248 North 9th st., Phila., Pa 9
Gas Purification—St. John and Cartwright 5
Gas Meters, etc.—Harris, Griffin & Co., 12th and Brown streets, Phila., Pa 10
Gas Meters, etc.—Wm. W. Goodwin & Company, 1012 Filbert street, Phila, Pa 17
Gas Meter Manufacturers—Harris & Bro., 1117 Cherry st., Philadelphia, Pa 11
Gas Fixtures, Etc.—Mitchell, Vance & Co., 597 Broadway 7
Gasholders, Etc.—Deily & Fowler, 39 Laurel st., Phila., Pa 4
Gas Screen—James P. Mahon, Boston, Mass 5
Lime Hurdles.—Manhattan Lime Hurdle Co., Geo. W. Day, Treas., No. 3 Railroad Square, Haverhill, Mass 2
Lava Tips and Scotch Tips—Charles H. Meyer & Co., 227 Chestnut street, Phil. Pa 8
National Tube Works Co., 78 William St., N. Y 7
Patent Conically Slotted Wood Trays—John L. Cheesman, 147 and 149 Avenue C., N. Y 4
Patent Gas Exhauster—Smith & Sayre, 95 Liberty street 4
Pelouze & Audouin Condenser—Jas. R. Smedberg, Sole Agent for U. S. San Francisco, Cal.; Henry Cartwright, 2107 Green street, Phil. Pa 1
Petroleum Gas—J. D. Patton, Treverton, Pa 4
Patent Gas Exhauster—S. S. Townsend, Agt, 31 Liberty street, N. Y 3

GAS COALS

Cannelton Coal Co. of West Virginia—J. Tatnall Lea, 325 Chestnut street, Phila, Pa 3
Despard Coal Co.—Parmelee & Bros., Agents, 32 Pine st., New York 7
Gas Coals—Perkins & Job, 27 South st., N. Y 7
New York and Cleveland Gas Coal Company—384 Penn Avenue, Pittsburgh, Pa 6
Penn Gas Coal Co.—11 Merchants' Exchange, Phil. and 90 Wall street, N. Y 6
Peytona Cannel Coal—S. E. Low, 58 Broadway, N. Y 5
The Newburg Orrel Coal Co.—Chas. W. Hays, Agent in New York, Trinity Building, 111 B'way, Room 7 6
Tyrconnell Gas Coal—52 S. Gay Street, Baltimore, Md 6
Westmoreland Coal Co.—230 South 3rd Street, Phil. Pa 6
Youghiogheny Coal—Perkins & Job, 27 South St. N. Y 7

FOUNDRIES.

Atlantic Dock Iron Works—John P. Kennedy, Office 98 Liberty street, N. Y., P. O. Box 2348 .....
Cast-Iron Pipes and Fittings—B. S. Benson, 52 East Monument street, Baltimore, Md .....
Continental Works—T. F. Rowland, Greenpoint .....
Camden Iron Works, Camden, N. J.—Jesse W. Starr & Son.
Gloucester Iron Works—J. P. Michellon, Sec., 6 North 7th street, Phila., Pa 4
Mill Street Foundry.—Geo. Stacey & Co., Cincinnati, O 5
National Foundry and Pipe Works—Wm. Smith, Carroll, Pike, Smallman & Wilkins streets, Pittsburg, Pa .....
Oregon Iron Foundry—Herring & Floyd, 740 Greenwich street, N. Y 10
Pascal Iron Works—Morris, Tasker & Co., Philadelphia 12
Providence Steam and Gas Pipe Co., Providence, R. I.—H. A. Branch, Agent 3

WATER METERS, PUMPS, ETC.

Cast Iron Pipes for Water and Gas—Riley A. Brick, 112 Leonard street, N. Y 10
Valves for Water, Steam and Gas—Ludlow Valve Man'g Co., 940 River street, Troy, N. Y 6

CLAY RETORT WORKS.

B. Kreischer & Son, Clay Retorts, etc., 58 Goerck st., N. Y. 8
Cheltenham Fire Brick and Clay Retort Works—Evens & Howard, 916 Market street, St. Louis, Mo .....
Manhattan Clay Retort Works, 15th st., near Av. C, N. Y. 8
Philadelphia Fire Brick Works, Vine and 23d sts., Phila. 8

LAMPS, STOVES, PETROLEUM, ETC.

Lamps—M. B. Dyott, 114 South 2nd Street, Phil. Pa. 1
Patent Lamp Post—J. W. Graham, Chillicothe, Ohio, or A. M. Callender, office of this Journal 9

MISCELLANEOUS.

Analysis and Testing of Gas Coals—Prof. Henry Wurtz, 12 Hudson Torrace, Hoboken, N. J. 10
Architect and General Gas Engineer—William Farmer, 111 Broadway Room 95, N. Y .....
Brass Cocks, Plumbers' Materials, etc., etc.—McNab & Harlin Manufacturing Co., 56 John st., N. Y 7
Cements—S. L. Merchant & Company, 76 South st., N. Y.
Contractors for Gas Works, Etc.—Murray & Baker, Fort Wayne, Ind 2
Fodell's System of Bookeeping—A. M. Callender & Co., 42 Pine st., New York 1
Gas Engineer—B. E. Chollar, 914 Olive St., St. Louis, Mo.
Gas-Light Company of America, 63 and 64 Drexel Building, New York 2
Kidd's Gas Consumers Guide—A. M. Callender & Co., 42 Pine Street, N. Y .....
Massachusetts Institute of Technology—Samuel Kneeland Boston, Mass .....
National Coal Gas Company—H. P. Allen, 4 Warren street New York 6
School of Mines, Columbia College, East 49th st 9
Screening Shovels—Herring & Floyd, 740 Greenwich st., New York 10
Scientific and Practical Chemist and Geologist—Professor Henry Wurtz, 12 Hudson Terrace, N. J 7
Screening Shovels—G. W. Dean, 1268 Broadway, N. Y. ....

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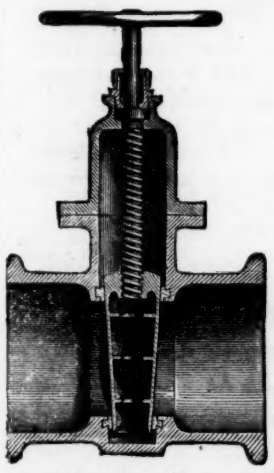


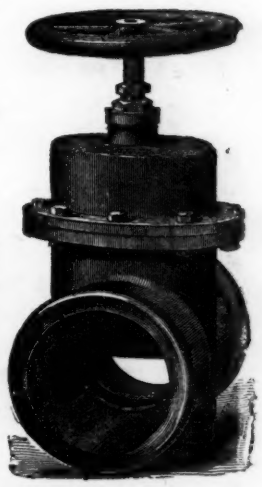
These Valves have been in use for several years, and are pronounced by all who have used them to be

The Best Gas Valves Ever Made.

They afford a direct passage the full size of the pipe. The seats are made of an alloy similar to BABBITT metal, specially prepared for the purpose, and superior to all other metals used for the seats of Gas Valves. It does not corrode under any circumstances to which it is exposed.

There is NO LIABILITY OF COHESION between the Gate and Seat, and the Valves can be relied upon to SHUT TIGHT and OPEN EASILY at all times—an important desideratum when used for street mains, in cases of fire.

We refer to the following named Gas-Light Companies among the many that have used these Valves:



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LAWRENCE GAS-LIGHT COMPANY, LAWRENCE, MASS.
PEOPLES GAS-LIGHT COMPANY, BROOKLYN, N. Y.
CITIZENS GAS-LIGHT COMPANY, BROOKLYN, N. Y.
SOUTH BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CHARLESTOWN GAS-LIGHT CO., CHARLESTOWN, MASS.
LYNN GAS-LIGHT COMPANY, LYNN, MASS.
FITCHBURG GAS-LIGHT COMPANY, FITCHBURG, MASS.
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GAS AND WATER VALVES ¾ INCH TO 36 INCHES DIAMETER.
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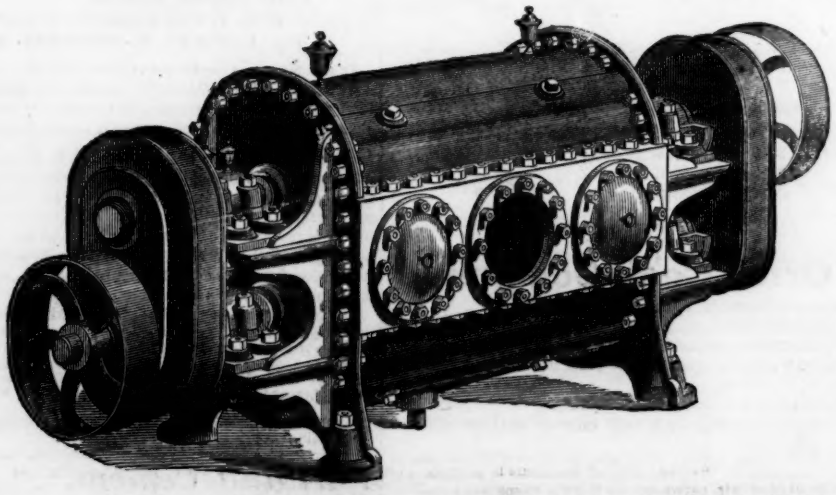

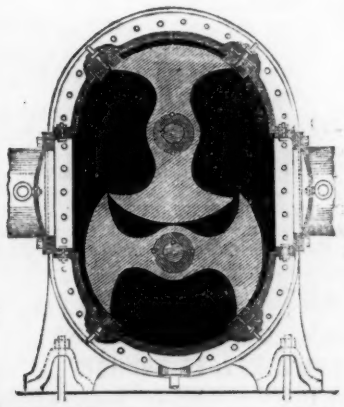

P. H. & F. M. ROOTS, PATENTEES AND MANUFACTURERS, CONNERSVILLE, IND.
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FOURTH.—The internal operating parts are practically gas-tight, but are not in actual contact, hence there is no internal friction or wear. The machine is therefore operated with less power than any other.

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We build them of any required capacity, large or small, adapted to any kind of works or place.

Send for Illustrated Catalogue, giving all particulars as to capacity, speed, power required, dimensions, and price of each size and references to parties using them.

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THE
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Their Property is located in the Youghiogheny Coal Basin, near Irwin's and Penn Station, on the Pennsylvania Railroad, and on the Youghiogheny River.

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366-1y

CANNELTON COAL CO.

OF WEST VIRGINIA.

Offer for sale the following Coals, from their Colliery at CANNELTON, Kanawha County, West Virginia, delivered at RICHMOND, Va.:

CANNELTON CANNEL,

acknowledged to be the most valuable ENRICHER produced in this country, a gross ton yielding 10,000 cubic feet of GAS of 64·54 CANDLE POWER; COKE 32 bushels, of good quality.

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Volatile Matter.	Coke.	Per cent. of Ash in		Sulphur in			Specif. Gravity.	
		Coal.	Coke.	Coke.	Oötl.	Volatile Matter.	Coal.	Gas.
35.1	64.9	2	6	.82	1.48	.66	1.289	.476

MAXIMUM YIELD, 5.06 cubic feet of Gas per pound of Coal—A yield of 4·78 cubic feet per lb.—gave 16 14-100 Candle-Power.

COKE, of very fine quality—1453 pounds produced from one ton of coal.

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THE SUBSCRIBER IS PREPARED TO CONTRACT FOR the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES McKELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

ESTABLISHED 1840. 357-1y

WREN'S GAS WORKS.

W. C. WREN,

Corner of Jay and Water Streets,

BROOKLYN. N. Y.

HAVING GRANTED THE USE OF ONE OF my Patents to the Gas-Light Company [of America, and settled my claim against them, I inform the profession that I continue to erect the Works known as

Wren's Gas Works,

and sell Licenses to use my Patents for making Gas from Petroleum.

Gentlemen of the profession:—As your consumers demand a better light, and as that demand has been in many cases sought in vain to be met by using different abortive imitations of my various processes, would it not be well to make success sure by trying the plan of the inventor.

You can enrich your Coal Gas to any desired standard, by using my process, in the simplest manner, and much cheaper than by *any other* method. Address as above.

THE NEWBURGH

Orrel Coal Company,

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Company's Office, No. 52 S. Gay Street, Baltimore, Md.

C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.

CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

SINCLAIR & AGNEW, Agents, Alexandria, Va.

This Company offer their very superior Gas Coal at lowest market prices.

It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

The best dry coals shipped, and the promptest attention given to orders. 294-1y

THE DESPARD COAL COMPANY

OFFER THEIR SUPERIOR

DESPARD COAL

To Gas Light Companies throughout the country.

Agents, PARMELEE BROTHERS, No. 32 Pine street, N. Y.

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Mines in Harrison County, West Virginia.
Wharves Locust Point, Company's Office, 29 South street, } Baltimore.

Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine.

☞ Reference to them is requested. 204-1y

NEW YORK AND CLEVELAND
GAS COAL COM'Y

Of Pittsburgh, Pa.

MINERS AND SHIPPERS OF

YOUGHIOGHENY GAS COAL.

This Company is prepared to furnish any amount of their justly celebrated, and acknowledged superior GAS COAL, to any point reached by railroad or navigation, on most favorable terms.

General Office—384 Penn Avenue,
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Branch Office—C. & P. RR. Coal Pier,
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WILLIAM A. McINTOSH, President.
A. CARNEGIE, Vice-President.
W. P. DE ARMIT, Treasurer.
THOMAS AXWORTHY, Agent at Cleveland, Ohio.

W. H. WATERBURY & CO., General Sales Agents, 137 Broadway, New York.
351-1y

PEYTONA
CANNEL COAL

From West Virginia.

Yields over 13,000 feet of Gas per ton. At ten thousand feet (standard yield) the illuminating power is over 43 candles. Purifies 4,510 feet to the bushel of lime.

S. E. LOW, Secretary,
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No. 4 Warren Street, New York.

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I. B. BRICE, Vice-President.
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WM. J. VALENTINE, Treasurer.
GEORGE W. HARRIS. Engineer.

This Company is the owner of the GWYNNE-HARRIS, or AMERICAN HYDROCARBON process, for making Gas for Lighting or Heating purposes, by the perfect decomposition of superheated steam, under what is known as the

GWYNNE AND HARRIS PATENTS.

This process has been fully tested nearly 50,000,000 cubic feet of Gas having been made under it, and fully demonstrating the fact that it is the greatest improvement ever made in the manufacture of Gas, either for Lighting or Heating purposes. With half a ton of Anthracite Coal 150,000 cubic feet of Gas per day is made from three benches, and the labor is so small that one man can attend three or four benches.

The process can be put into either Coal or Oil Gas Works (or where both Coal and Oil are used) at small cost, without any interruption to the working of other benches. The Citizens Gas-Light Company of Brooklyn, after using it for more than seven months, have found it not only far better, but actually *cheaper* than atmospheric air in making Gas, with the use of "petroleum and its products."

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Portland Cement,
Roman Cement,
Keene's White Cement,

NUMBERS 1 AND 2.

From best London Manufacturers.

FOR SALE BY

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Corner Maiden Lane. 344-1y

☞ Remit 10 cents postage for "Practical Treatise on Cement."

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WROUGHT IRON

ENAMELED GAS AND WATER PIPE,

MANUFACTURED SOLELY BY THE

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ALSO MANUFACTURERS OF

Lap-welded Steam and Gas Pipe,
Tubing and Casing for Artesian, Oil and Salt Wells (WITH PATENT PROTECTING COUPLING),
Lap-welded Iron Boiler Tubes,
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WORKS AT BOSTON, MASS., AND McKEESPORT, PENN.

OFFICES AND WAREHOUSES.

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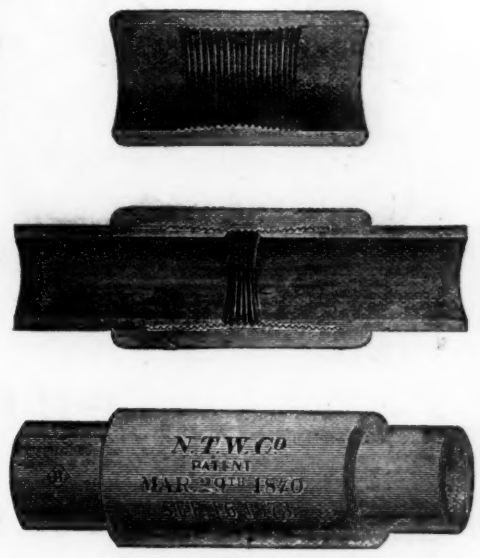

THE WAVERLY COAL AND COKE CO.

Offer for Sale the

YOUGHIOGHENY COAL

DOUBLE SCREENED,

from their Colliery at Smith's Mills, on the Youghiogheny River, thirty-seven and a half miles southerly of Pittsburgh. This Coal has the preference in Pittsburgh over all other YOUGHIOGHENY COAL for GAS PURPOSES.

The facilities of the WAVERLY COMPANY are unsurpassed by those of any other Company on the Youghiogheny.

Full particulars can be had by addressing

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CHARTERED 1854.

MINES situated on the **Pennsylvania** and the **Connellsville Railroads** in **Westmoreland County, Pa.**

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Since the commencement of operations by this Company its well known

BITUMINOUS COAL

has been largely used by the **GAS COMPANIES, RAILROADS,** and **IRON and STEEL WORKS** in the **New England** and **Middle States,** and its character is established as having no superior for freedom from sulphur and other impurities.

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200 Tons
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CORNER OF

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Clay Gas Retorts,
Gas House Tiles,
Fire Bricks, Etc. Etc.
Ground Clay, Fire Brick and Fire Sand in Barrels,

ALWAYS ON HAND.

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MITCHELL, VANCE & CO.,

Manufacturers of

CHANDELIERS!

And Every Description of

GAS FIXTURES,

Also Manufacturers of

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Special designs furnished for Gas Fixtures for Churches ubl ic Halls Lodges. &c.

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CAST IRON PIPES,

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OF EVERY DESCRIPTION,

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KENSINGTON FIRE BRICK & CLAY
RETORT WORKS.
Kensington Fire Brick Works, Beach & Poplar Sts.
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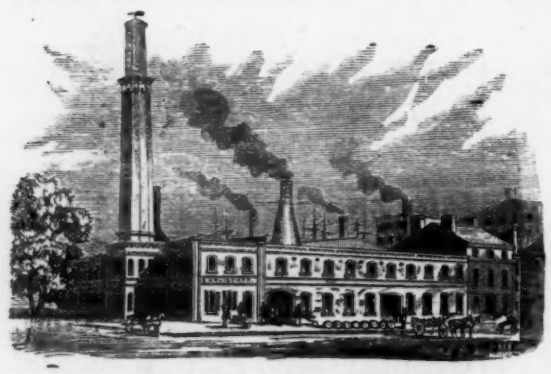
(SUCCESSOR TO JOHN NEUKUMET),

Manufacturer of Fire Bricks, Tiles, Gas and Sugar House Retorts.

☞ Plans of Settings for Benches of Threes, Fives, and Sixes furnished, free of charge, upon application.



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☞ *Established* in 1845. ☜
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GAS RETORTS, TILES & FIRE BRICK
Of all shapes and sizes.

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Articles of every description made to order at th shortest notice.

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Cast Iron Gas and Water Pipe.

Works—Burlington, N. J.

Having withdrawn from the firm of R. D. Wood & Co., the practical management of which we have had since the organization of that firm until June 1871, we have now completed our Works for the manufacture of CAST IRON PIPE and Castings generally.

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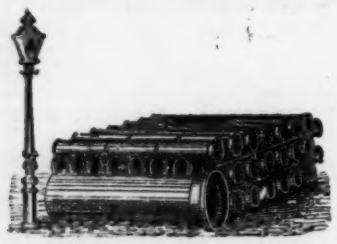
Our experience in the manufacture of Pipe for a great many years, has enabled us in rebuilding to practically apply Machinery and Fixtures of the very best character, to insure *good work*.

We are now prepared to contract for this class of Castings under the most favorable terms.

Office and Works Burlington, N. J.



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Lamp Posts, Valves, Etc.
Mathew's Pat. Anti-Freezing Hydrants.
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ALL ORDERS DELIVERED FREE TO N W YORK.
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Cast Iron Heating and Steam Pipe. Stop Valves. water or Gas.

Fire Hydrants,
GAS HOLDERS

JAMES MARSHALL & CO.

Franklin Foundry and Pipe Works,

MANUFACTURERS OF

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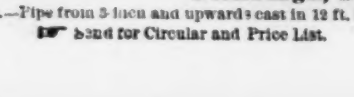

Works, 18th, 19th, 20th and Railroad Street.
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8.—Pipe from 3-inch and upwards cast in 12 ft. lengths.
☞ Send for Circular and Price List.

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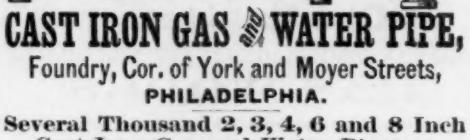

CAST IRON GAS AND WATER PIPE,

Foundry, Cor. of York and Moyer Streets,
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Several Thousand 2, 3, 4, 6 and 8 Inch Cast Iron *Gas and Water Pipes* on hand, for immediate delivery.

☞FITTINGS FOR GAS AND WATER MAINS.☜

MANHATTAN
FIRE BRICK & ENAMELLED CLAY
RETORT WORKS.

ADAM WEBER,
(Successor to MAURER & WEBER.)
PROPRIETOR.
Office and Works, 15th Street, Avenue C.
Manufactures of
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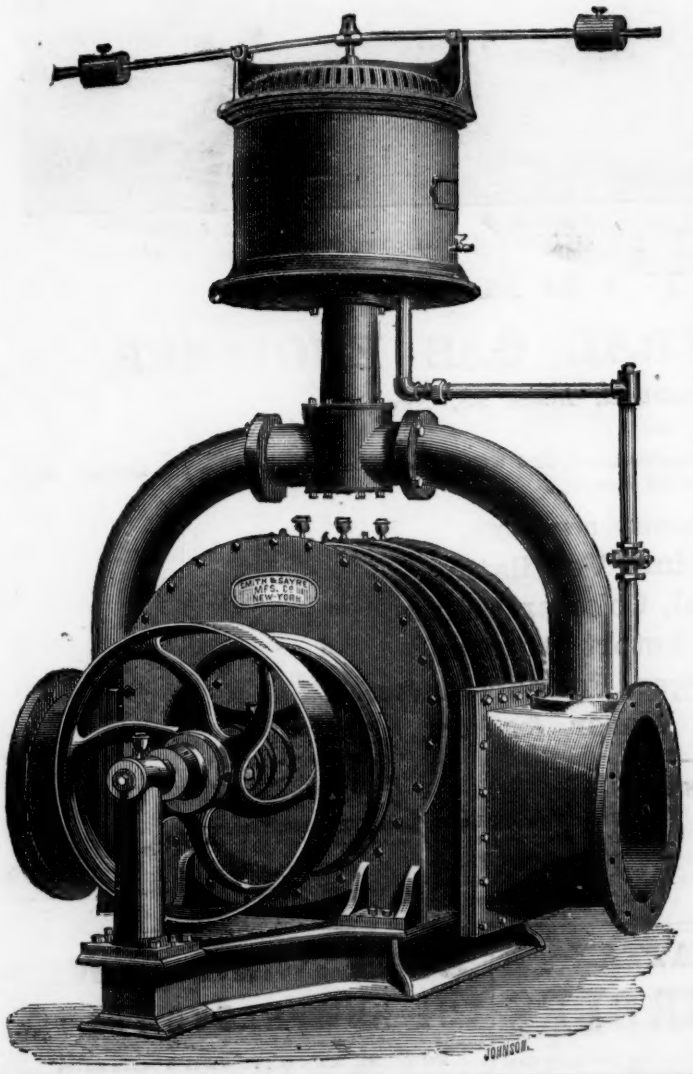
Of all shapes and sizes.
FIRE MORTAR, CLAY AND SAND.
☞ Articles of every description made to order at short notice. 1y5

SMITH & SAYRE MANUFACTURING COMPANY.

The Mackenzie Patent Gas Exhauster

And Patent Compensator.



They are made to pass from 4,000 to 150,000 cubic feet of gas per hour; will increase the production and illuminating power of the gas, and add very much to the durability of the retorts, either clay or iron. The Compensator obviates entirely the necessity of water-jo ints, is compact, durable, cleanly, not liable to get out of order, self-acting, quiet, and certain in its operation.

We are also sole proprietors and manufacturers of the

MACKENZIE PATENT BLOWER, PATENT CUPOLA AND SMELTING FURNACE.

The Blower is a Force Blast machine, durably built, and can be driven with one-third the power required to drive the ordinary Fan

The Cupolas are manufactured in sizes to melt from 1 to 90 tons per hour, will save one quarter of the time required by the old style Cupola and 33 per cent fuel. Address

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JAMES M. SAYRE, Treasurer. OFFICE, 95 LIBERTY STREET, New York.

[CHARLES W. ISBELL, Secretary.

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S. F. DEWEY, V. Pres. } OFFICE OF {CHAS. F. DEAN, Sec.

THE GAS-LIGHT CO. OF AMERICA

Nos. 63 and 64 Drexel Building,

P. O. Box, 5131. NEW YORK.

THE GAS-LIGHT COMPANY OF AMERICA, owners of the Patent Processes for making ILLUMINATING GAS from PETROLEUM and its products, known as the

Gale and Rand

AND

Wren and Barker Patents,

are prepared to treat with Gas Companies and Manufacturers of Gas for the use of said processes.

An examination of the merits of these inventions as demonstrated by practical experience in a large number of Gas Works employing them, will not fail to convince the intelligent Gas Manufacturer of the great advantages derived from their use.

Gas of unexceptional quality, of high illuminating power is made at many of these works by these processes, at a cost of from 40 per cent. to 60 per cent. less than an ordinary qualito of illuminating gas can be made by any other methods in use. Gas Companies generally may easily, and at small outlay for making the necessary changes in manufacturing apparatus, double their net earnings, and supply a much better light their patrons, at greatly reduced prices.

The Company respectfully refer to Companies using these processes in this city, Reading, Penn., Chicago and elsewhere, and especially to the Mutual Gas-Light Company of Detroit, Mich., whose works more nearly conform in all details of construction to the original plans of the inventors, than those of other Companies.

For Correspondence, etc., address to office as above.

CHARLES F. DEAN, Secretary

1842. DEILY & FOWLER. 1876.

LAUREL IRON WORKS.

ADDRESS, 39 LAUREL STREET,

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MANUFACTURERS OF

GAS HOLDERS,

SINGLE AND TELESCOPIC—WITH CAST OR WROUGHT IRON GUIDE FRAMES.

We are prepared to furnish Holders, Wrought Iron Roof Frames, Bench Castings, Condensers, Scrubbers, Purifiers, Drips, Bends, Tees, and all other Iron Work connected with Gas Works. Previous to 1868 our Mr. D. built *nine Gas Works* and *fifty-four Holders*. Since that date we have built *three Gas Works* 9nd *forty-six Holders*. We *superintend in person* the erection of all our work, and would refer to the Gas Companies at the following places, where we have built Holders, since 1868:

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Pittston, Pa.
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Sharon, Pa.
Canton, Pa.
Annapolis, Md.
Parkersburg, West Va.
Lynchburg, Va.
Jamestown, O
Steubenville, O.
Zanesville, O.
Mansfield, O.
Marion, O.
Bellcaire, O.
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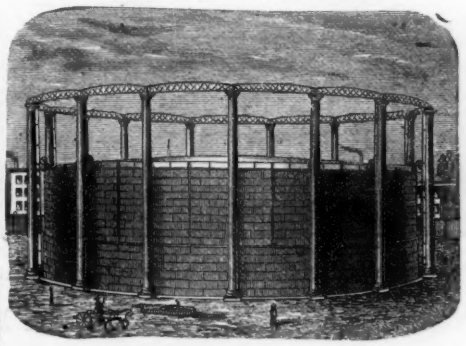

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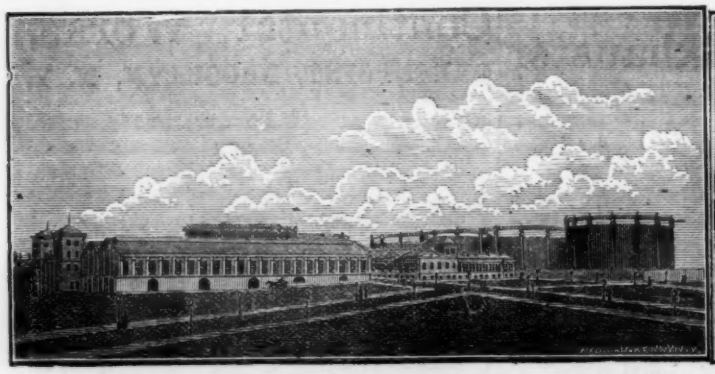

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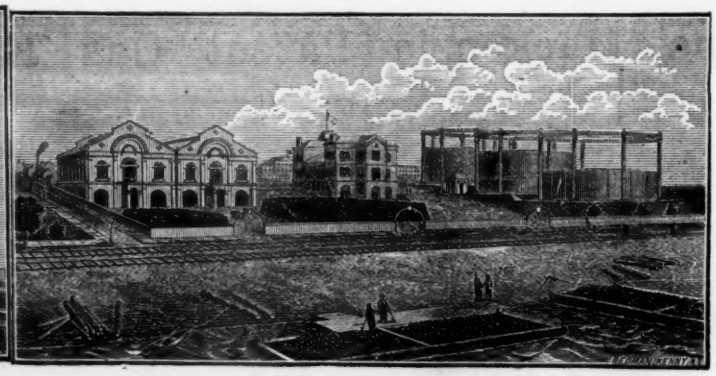

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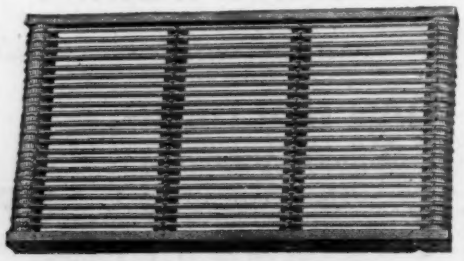

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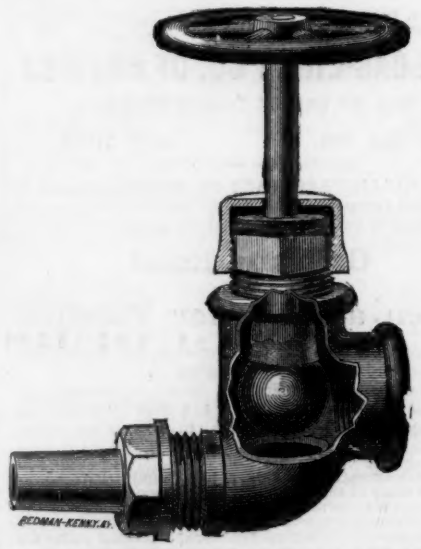

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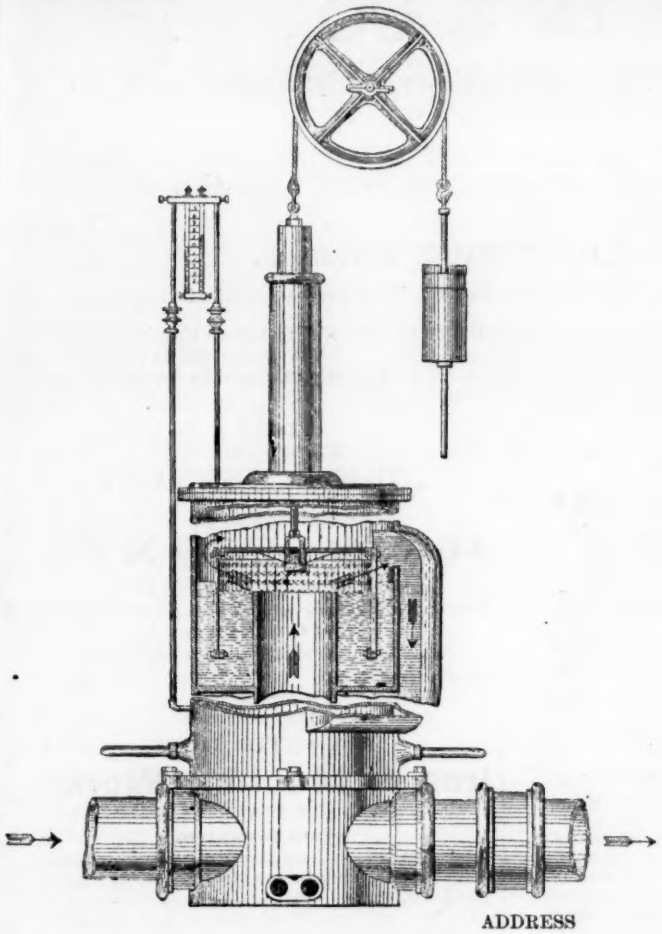

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C. GEFRORER,

Manufacturer of

GAS BURNERS,

GAS HEATING AND COOKING APPARATUS

FITTERS' PROVING APPARATUS, ETC.,

No. 248 North Eighth Street, Philadelphia.

THOMAS T. TASKER Jr. STEPHEN P. M. TASKER.

MORRIS, TASKER & CO.,

PASCAL IRON WORKS, PHILADELPHIA.

TASKER IRON WORKS, NEWCASTLE, DEL.

Office, Fifth and Tasker Streets, Philadelphia.

Office and Warehouse, 15 Gold Street, New York.

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Established 1821.

FOR GAS WORKS MACHINERY, ADDRESS OFFICE, FIFTH AND TASKER STREETS, PHILADELPHIA.

Manufacturers and Builders of Gas Works, &c., of all Descriptions, of the Most Approved Plans.

WROUGHT IRON ROOF FRAMES.—For Slate, or Corrugated Iron Coverings, with Cast Iron Cornice Gutter. Iron Doors and Frames, Wrought Iron Pivot Blinds, Windows and all kinds of Castings and Smith Work for Buildings.

BENCH CASTINGS.—Retorts, and all Castings and Wrought Iron Work required for Setting them on the Latest Plan. Tar Gates, Wrought Iron Stand Pipes, Retort Lids, Cotter Bars, Coal and Coke Wagons, and Stokers' Tools.

EXHAUSTERS.—Exhausters and Compensators, By-Passes to pass from 4,000 to 150,000 Cubic feet of Gas per hour, with Engines, Governors, Pressure and Vacuum Guages.

SCRUBBERS.—Single or Multitubular Scrubbers, with Self-Acting Pumps for Ammonia Water.

WASHERS.—Cataract and Single and Multitubular Spray Washers

CONDENSERS.—Single and Multitubular Air and Water Condensers.

PURIFIERS.—For Purifying from 1,000 to 2,000,000 cubic feet capacity daily, with either wet or dry Lime, or Oxide of Iron, and with either Ash Rivetted or Wrought or Cast Iron Lime Sieves.

CARRIAGES.—Movable Lifting Carriages for Purifiers, arranged either for Floor or Overhead use.

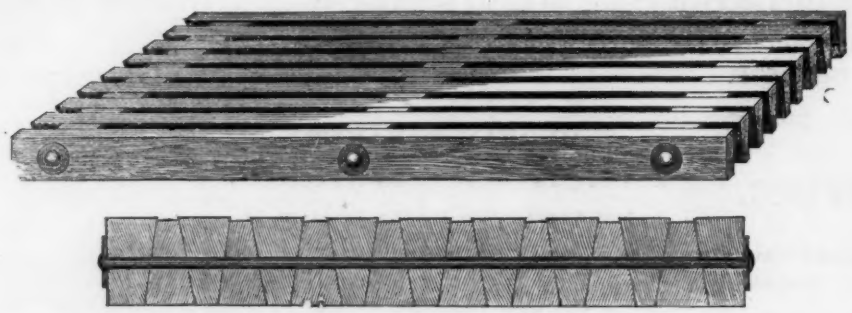
METERS.—Square and Round Meters of any capacity.

GAS HOLDERS.—Single Lift and Telescopic Gasholders, with Cast or Wrought Iron Suspension Frames.

GAS GOVERNORS.—Station Governors, with Regulating and Indicating Columns for Inlet and Outlet Pipes, also Dry Governors with Flexible Diaphragms for Underground Pipes.

STOP VALVES.—Double Faced Stop Valves for Gas or Water, from three inches to forty-eight inches diameter. These Valves are proved on both sides, with a heavy Water Pressure, Flange and Bell Pipes, Fittings and Drips of all descriptions. Steam Boilers and Hot Water Apparatus for Heating Building, and Gas Holder Tanks. Lamp Posts and Lanterns.

P. Munzinger's Patent Ash Lime Trays.



In use at the following Gas-Light Companies:

Pittsburg Gas Company, Pa.
Peoples Gas Company, Baltimore.
Lowell Gas-Light Company, Mass.
Lynn Gas-Light Company, Mass.
Albany Gas-Light Company, N. Y.
Schenectady Gas-Light Company, N. Y.
Utica Gas-Light Company, N. Y.
Jersey City Gas Company, N. J.
St. Paul Gas-Light Company, Minn.
Cumberland Gas-Light Company, Md.
Hartford City Gas-Light Company, Conn.
Richmond Gas Company, Va.
McKeesport Gas Company, Pa.
Middletown Gas Company, Pa.
East Newark Gas-Light Company, N. J.
Binghampton Gas Company, N. J.
Zanesville Gas Company, Ohio.

New Orleans Gas Company, La.
Salem Gas-Light Company, Mass.
New Britain Gas-Light Company, Conn.
Rahway Gas-Light Company, N. J.
Trenton Gas-Light Company, N. J.
Elmira Gas Company, New York.
Erie Gas Company, Pa.
Columbus Gas-Light Company, Ohio,
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Salem Gas Company, N. J.
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Williamsport Gas Company, Pa.
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Augusta Gas-Light Company, Ga.
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Chattanooga Gas Company Tenn.
Murfreesboro Gas Company, Tenn.
Hagerstown Gas-Light Company, Md.
Hanover Gas Company, Pa.
Easton Gas Company, Pa.
Uniontown Gas-Light Company, Pa.
Coatesville Gas-Light Company, Pa.
Houston, Gas Company, Texas.
Wilkesbarre Gas Company, La.
Middletown Gas Company, New York.
Washington Gas-Light Company, Pa.
Princeton Gas-Light Company, N. J.
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